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I.—PROPERTIES OF METALS

*Tensile Strength of Aluminium: Experimental Determination of Value at the Melting Point. Giordano Bruni (*Metal Ind.*, 1947, **70**, (4), 71–72).—The tensile strength of solid aluminium at the m.p. (660° C.) is 38 kg./cm.² (540 lb./in.²). This value has been confirmed by extrapolation of the tensile strength of the annealed metal–temp. curve. This curve and that giving the tensile strength of the rolled metal converge towards the m.p.
—J. H. W.

Mechanism of Natural Oxidation of Aluminium, Iron, and Copper. Scott Anderson (*Phys. Rev.*, 1946, [ii], **69**, (1/2), 52).—A summary of a paper presented to the American Physical Society. A.'s theory of electrolytic oxidation of aluminium has been extended to include the natural oxidation of aluminium, iron, and copper. When so applied, it appears that space charges control the rate of growth in the early stages. Equations are devised for the three stages of growth : (1) when the mean-free-path of the moving particles is large in comparison to the oxide thickness, (2) when the mean-free-path of the moving particles is small in comparison to the oxide thickness, and (3) when the oxide is so thick that space charges are no longer the controlling factor. These equations predict a third-power law of rate of growth for stage (1), a fourth-power rate for stage (2), and a quadratic law of growth for stage (3). The equations agree quite well with the observed rates.—AUTHOR.

*The Atomic Weight of Beryllium. O. Hönigschmid and T. Johannsen (*Z. Naturforschung*, 1946, **1**, (11/12), 650–655).—The international chemical atomic weight of beryllium differs by a relatively large amount from those calculated from the measurements of mass spectroscopy and nuclear physics. H. and J. have therefore made two new chemical determinations of it, one of them by a new method. Anhydrous beryllium chloride was synthesized by a dry method from the purest beryllium oxide, carbon, and chlorine, and sublimed once in a stream of chlorine, once in a stream of nitrogen, and three times in a high vacuum. In a completely analogous manner, beryllium bromide was synthesized and purified by high-vacuum sublimation. The ratios $BeCl_2 : 2Ag : 2AgCl$ and $BeBr_2 : 2Ag : 2AgBr$ were ascertained and the atomic weight of beryllium eventually calculated as 9.013 ± 0.0004. This agrees well with the mass-spectrographic value, but is lower than the international value of 9.02.—F. M.

*Ultrasonic Measurements on Single [Copper] Crystals. H. B. Huntington (*Phys. Rev.*, 1947, [ii], **72**, (4), 321–331).—A pulse technique at 10 Mc./s. has been used to measure acoustic velocity and attenuation in single crystals. The numerical data given refer to alkali halides and Rochelle salt, but measurements were also made with single crystals of copper which showed a very large attenuation compared with alkali halides. Internal friction in the copper crystals was high compared with that found at lower frequencies.
—W. H.-R.

On the Atomic Magnetic Moments of Fe, Co, and Ni. F. M. Galperin (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (3), 211–213).—[In English]. It is suggested that the atomic magnetic moment m, corresponding

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* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

to its interatomic distance $d_{\text{eff.}}$, could be obtained from the expression $m = M - k \mid d_{\text{eff.}} - D \mid$, where M is the max. magnetic moment and $D = R + r$, where R and r are radii corresponding to the max. radial densities of the electron charge created by the s and d shells.—V. K.

*The Thermodynamic Properties of Manganese. K. K. Kelley, B. F. Naylor, and C. H. Shomate (*U.S. Bur. Mines, Tech. Paper* No. **686**, 1946, 34 pp. ; *C. Abs.*, 1946, **40**, 4944).—Low-temp. specific-heat measurements of α- and γ-manganese (electrolytic) were made through the range 52°–298° K. The entropies of both varieties were evaluated. High-temp. heat content of electrolytic manganese was measured to 1436° K. The data suffice to derive heat-content equations for all 4 crystalline modifications. Values of the transition temp. and heats are included. Electronic energy-level data for manganese gas were utilized to obtain its thermodynamic properties to 500° K. These thermal data are combined to derive a rectified vapour-pressure curve for liquid manganese and values of the heat entropy, and free energy of vaporization and sublimation.

*Measurements on the Electrical Resistivity of Thin Nickel Films. A. van Itterbeek and L. de Greve (*Experientia*, 1947, **3**, (7), 278–279).—[In English]. In previous work I. and G. found that thin nickel films, obtained by cathodic discharge, showed a minimum resistance at a temp. depending on the thickness, when this exceeded 40 mμ. New measurements show that the temp. of the minimum also depends strongly on the conditions under which the films were formed. If sufficiently heated, the minimum disappears, along with deviations from Ohm's law. It is concluded that the electrical properties of these films depend strongly on the state of crystallization of the film.—F. M.

Rhodium : Engineering Properties and Uses. L. B. Hunt (*Metal Ind.*, 1947, **71**, (17), 339–342).—H. describes the physical properties of rhodium and discusses in detail its applications in the electrodeposited form as a permanent protective finish against atmospheric and marine corrosion, as an electrical contact surface, and as a reflecting surface for either visual or infra-red radiation.—J. H. W.

*Density of Surface States on Silicon Deduced from Contact-Potential Measurements. W. H. Brattain and W. Shockley (*Phys. Rev.*, 1947, [ii], **72**, (4), 345).—A note. The contact potentials of several N- and P-type silicon surfaces were measured relative to a standard surface of platinum. After grinding flat, the silicon surfaces were sand-blasted lightly with 180-mesh silicon carbide, and the contact potential was measured in air, in a vacuum after heat-treatment to 400° C., in high-purity nitrogen, and finally again in air. After heat-treatment in a vacuum, the contact p.d. between the two types of silicon increases, and this confirms the surface-state picture given by Bardeen (*Phys. Rev.*, 1947, [ii], **71**, 717 ; *Met. Abs.*, this vol., p. 98). The density of surface states in silicon is approx. 10^{14}/V./cm.^{2} for the specimens treated in a vacuum ; the surface in air behaves as though the density of surface levels were increased by several orders of magnitude.—W. H.-R.

*Evidence for Surface States on [Silicon and Germanium] Semi-Conductors from Change in Contact Potential on Illumination. W. H. Brattain (*Phys. Rev.*, 1947, [ii], **72**, (4), 345).—Cf. preceding abstract. A note. Experiments have been made to examine the influence of exposure to light on the contact potentials of surfaces of N- and P-type silicon, and of N-type germanium. The contact-potential changes due to light exposure at 120° K. were + 0·12 and − 0·08 V. for N- and P-type silicon, respectively, and + 0·02 V. for N-type germanium. The changes are instantaneous on exposure to light, but on replacing in darkness the return to equilibrium conditions takes a few seconds. The results are in the direction expected from the surface-state picture of Bardeen (*Phys. Rev.*, 1947, [ii], **71**, 717 ; *Met. Abs.*, this vol., p. 98). No similar changes were found at room temp.—W. H.-R.

Titanium and Zirconium: Two Metals of the Future. W. J. Kroll and A. W. Schlechten (*Metal Ind.*, 1946, **69**, (16), 319–322).—The laboratory preparation and properties of titanium and zirconium are reviewed. The large-scale preparation of titanium, depending on the reduction of pure titanium chloride with magnesium in a furnace with an argon or helium atmosphere, is described. The large-scale preparation of zirconium is similar, except that special techniques are required to overcome the difficulties associated with the sensitiveness of the metal to oxygen and nitrogen. 10 references are given.—J. H. W.

On the Relation of the Strength of Materials to the Stressing Time. T. A. Kontorova (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (1), 23–26).—[In English]. The problem of deformation and failure of materials subjected to tensile stress is treated mathematically, and a function is developed relating the value of the strength of material to the time of duration of stress.—V. K.

On the Stress–Strain Relations in the Theory of Plasticity. L. M. Kachanov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (4), 309–310).—[In English]. An analysis of Hencky's generalized theory of plasticity.—V. K.

On a Possible Explanation of the Bridgman Effect—The Increase in Strength Under Uniform Pressure on All Sides. V. L. Herman (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **51**, (9), 671–674).—[In English]. A theoretical explanation of the Bridgman effect is suggested. Calculated increases in strength are of the same order of magnitude as those obtained experimentally.
—V. K.

Friction Between Solid Bodies. F. A. Vick (*Sci. Progress*, 1947, **35**, (139), 484–489).—A review of theory, chiefly devoted to problems of friction involving metals.—F. M.

*Visible Hot Spots on Sliding Surfaces. F. P. Bowden and M. A. Stone (*Experientia*, 1946, **2**, (5), 186–188).—[In English]. Polished surfaces of glass or quartz were rubbed over metal ones. Frictional heating at raised points of contact produced visible points of light at very low loads and speeds. Indirect evidence showed local temp. of at least 520° C. must be attained. Local hot spots are important in various physical processes, including the polishing and surface flow of solids, and the seizure of metals.
—F. M.

*The Calculation of Variable Heat Flow in Solids. N. R. Eyres, D. R. Hartree, J. Ingham, R. Jackson, R. J. Sarjant, and J. B. Wagstaff (*Phil. Trans. Roy. Soc.*, 1946, [A], **240**, (813), 1–57).—A method of evaluating the equations of heat flow in bodies under non-steady conditions, employing the differential analyser, is developed and applied to the cooling of a cast steel ingot. Plots of temp. against cooling time show excellent agreement with observed results for the centre of an ingot (though it is not so good elsewhere), and it is feasible to evaluate the internal temp. distribution from a knowledge of the outer mould-surface temp. alone. A solidification time of the right order of magnitude was calculated.—F. M.

*An Experimental Investigation of the Flow of Liquid Metal in an Open Channel. E. Z. Rabinovitch (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (3), 201–203).—[In French]. The nature of the flow of liquid metal in an open channel of triangular section was studied by measuring, with a specially designed apparatus, the distribution of velocity over the cross-sectional area. The flow in the case of cast iron flowing in a sand mould is essentially turbulent, the value of Reynolds number being $9 \times 10^5 + 1 \times 10^6$.—V. K.

On the Formulæ of the Coefficient of Friction in the Flow of Liquid Metals. E. Z. Rabinovitch (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (5), 391–393).—[In French]. Results obtained by Ruff on the liquid flow of

metals were re-examined. The author believes that the assumptions Ruff made were not justified and that erroneous conclusions were reached. An alternative method of interpreting Ruff's results is suggested.—V. K.

*A Note on Fusion and the Hole-Theory of Liquids. A. G. Chowdri and F. C. Auluck (*Phil. Mag.*, 1946, [vii], **37**, (274), 809–811).—Auluck and Kothari (*Proc. Camb. Phil. Soc.*, 1945, **41**, 180) have constructed the Schrödinger equation for a hole in the hole-theory of liquids, and determined the eigen-values of its energy. The results are applied to the phenomenon of fusion, and data given for nine metals. The agreement between experiment and theory is not unsatisfactory in view of the crude nature of the latter.
—W. H.-R.

*Investigation of the Surface Photo-Electric Effect of Metallic Films Under the Influence of Strong Electrostatic Fields. Vincent P. Jacobsmeyer (*Phys. Rev.*, 1946, [ii], **69**, (1/2), 50).—A summary of a paper presented to the American Physical Society. The investigation was a preliminary test of the Guth–Mullin theory of the " photo-electric analogue of the Schottky effect ". The variation of the photo-electric current with strong electrostatic fields (at least to 1.4×10^5 V./cm.) was observed for various conditions of the photo-electric surface and for different cathode–anode geometries. The emission surfaces were bismuth films of approx. 900 and 500 atom-layers, respectively, deposited at room temp. by evaporation in a high vacuum on a surface of liquid bright platinum, and also a liquid bright platinum surface not covered with bismuth. The photo-electric currents for sixteen runs fluctuate about a fixed reference " Schottky line " (the most probable straight line though the experimental points as calculated by the method of least squares). A comparison of the position of the maxima and minima of the curves obtained is made with the experimental thermionic results of Seifert and Phipps and the theoretical derivations for the photo-electric current by Guth and Mullin. It is concluded that a real variation of photo-electric current with applied electric field is observed, which has the approx. periodic character predicted by Guth and Mullin.—AUTHOR.

*Photogalvanic Effect in Metals. I. D. Kirvalidze (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (6), 491–494).—[In English]. Changes in the potential of a metallic surface irradiated by ultra-violet light were measured. The results show that an increased positive potential is produced which could be accounted for by both the external photo-electric effect and the ejection of electrons from the surface into the metal.—V. K.

On the Existence and Uniqueness of the Solution of the Fundamental Equation in the Theory of Metallic Conduction. L. J. F. Broer (*Proc. K. Ned. Akad. Wetensch.*, 1947, **50**, (8), 885–891).—[In English]. By imposing certain conditions, a unique solution may be obtained to the fundamental Lorentz–Bloch equation. This problem constitutes the so-called third fundamental problem in the theory of metallic conduction.—F. M.

*The Magnetic Threshold Curves of Supraconductors. John G. Daunt (*Phys. Rev.*, 1947, [ii], **72**, (1), 89–90).—A note. According to Kok (*Physica*, 1934, **1**, 1103 ; *Met. Abs.*, 1935, **2**, 211), the magnetic threshold curves of supraconductors are approx. parabolic functions of temp. Recently, a three-halves power function has been suggested by Sienko and Ogg (*Phys. Rev.*, 1947, [ii], **71**, 319 ; *Met. Abs.*, 1947, **14**, 310), but Stout (*Phys. Rev.*, 1947, [ii], **71**, 741 ; *Met. Abs.*, this vol., p. 99) concluded that the original parabolic function of Kok was the more probable. Previous very accurate data for mercury are examined in detail, and these confirm the parabolic relation, and prove the relation proposed by Sienko and Ogg to be unsatisfactory. Recent work on mercury (Désirant and Schoenberg, *Nature*, 1947, **159**, 201 ; *Met. Abs.*, 1947, **14**, 242) are discussed, and lead to the conclusion that the number n_s of electrons taking part in supraconductivity is proportional to T^3, the

function being of the form $n_s = n_0[1 - (T/T_c)^3]$, where T_c is the critical temp. on the absolute scale. Analogies with superfluid helium are discussed.
—W. H.-R.

*Supraconductivity and the Debye Characteristic Temperature. Jules de Launay and Richard L. Dolecek (*Phys. Rev.*, 1947, [ii], **72**, (2), 141–143).—A diagram is reproduced in which the supraconducting threshold temp. are plotted against the Debye characteristic temp. of the elements concerned. In this diagram, the points for tin, tantalum, niobium, and vanadium lie apart, while those for the remaining elements lie approx. on a curve which shows a marked bend at a characteristic temp. of approx. 120° K. This relation is discussed in connection with previously known relations involving the atomic vol., and attempts are made to predict which additional elements might exhibit supraconductivity.—W. H.-R.

*The Passage of Liquid Conductors Through Minute Orifices in Dielectrics. M. V. Griffith and A. Morris Thomas (*Phil. Mag.*, 1947, [vii], **38**, (277), 81–96).—The passage of mercury through films of cellulose acetate under the action of high electric potential was examined, and was found to occur only after the film had been punctured by an electric discharge. The work was then extended to include the passage of mercury through very thin glass capillaries. It was shown that when mercury is separated from a semi-conducting liquid by a dielectric containing a small hole or orifice, the effect of producing a difference of potential of several thousand volts between the mercury and an electrode immersed in the liquid is the passage of mercury through the hole in a very finely divided condition. The method may be used for preparing colloidal mercury. The action does not occur if the liquid has a resistivity greater than 10^9 ohm-cm., and stable suspensions are not formed if the resistivity is less than 10^6 ohm-cm. The theory of the process is developed.—W. H.-R.

*The Deflection of Charged Particles in a Ferromagnetic Medium. Gregory H. Wannier (*Phys. Rev.*, 1947, [ii], **72**, (4), 304–312).—W. H.-R.

Metallurgy and Atomic Energy. C. Hubert Plant (*Metallurgia*, 1947, **37**, (217), 15–19).—A survey of modern theories of atomic structure.—M. A. V.

II.—PROPERTIES OF ALLOYS

Wrought Aluminium Alloys. R. Chadwick (*Metal Ind.*, 1947, **70**, (23), 415–418; (24), 435–438; (25), 455–458; (26), 484–486).—A paper read to the Swansea Local Section of the Institute of Metals. C. classifies and describes the characteristics of commercial wrought aluminium alloys from the point of view of users. 36 references are given.—J. H. W.

*Alclad : An Investigation of Some Stress–Strain Characteristics. W. Thompson (*Metal Ind.*, 1946, **69**, (23), 465–466).—Accurately prepared load–elongation diagrams showed that with aluminium-coated aluminium alloys there is a distinct change in the slope of the straight-line portion of the diagram. This was observed in the alloys D.T.D. 390, 546, and 610 in the " as-received " condition, but not after the coating had been stripped off, nor after heat-treatment. This shows that the phenomenon is associated with the work-hardening of the coating during the straightening of the sheet. Vickers hardness tests also showed that there is a wide difference between the " as-received " and heat-treated conditions of these alloys.—J. H. W.

Aluminium-Clad Light Alloys. —— (*Eng. Materials Processes*, 1947, **5**, (18), 90–91).—Reference is made to 8 British Standard Specifications dealing with Alclad, and the compositions of various British and foreign Alclads are listed.—H. A. H.

*Stretching Aluminium-Clad Alloys. (——). See p. 206.

The Present State of Knowledge Regarding Inclusions in Light Alloys. Marcel Bardot (*Fonderie*, 1947, (**18**), 684–691).—A review, dealing with all " hard inclusions and phases " in light alloys, with special reference to alumina inclusions. Some early work is discussed, together with recent French work. The conditions under which massive alumina or magnesium spinels, as distinct from alumina skins, are encountered are described. The possibilities of the reduction of various oxides by aluminium are mentioned.
—S. M.

Bearing Metals: **Modern Developments for the High-Speed Diesel Engine.** P. T. Holligan (*Metal Ind.*, 1947, **70**, (21), 375–377; (22), 402–404; (23), 419–420; correspondence, **71**, (4), 73).—A paper read to the Scottish Local Section of the Institute of Metals. H. describes the properties required for bearings in the modern high-speed Diesel engine, their structure, the thickness of the lining, and cadmium-base, aluminium-base, lead-bronze, and copper–lead bearing alloys.—J. H. W.

Bearing Alloys and Manufacturing Technique. (Gall). See p. 201.

Beryllium and Its Alloys. G. Fitzgerald-Lee (*Eng. Materials Processes*, 1947, **5**, (18), 100–101).—A review.—H. A. H.

*Chill-Cast Tin Bronzes: Effect of Zinc Content on Physical Properties. K. Winterton (*Metal Ind.*, 1946, **69**, (15), 297–299).—The effect of adding 2·5–10% of zinc on the casting characteristics and mechanical and physical properties of chill-cast bronzes containing 5–15% tin was investigated. It was found that zinc impairs the soundness and strength of all the bronzes examined, and that there is no advantage in using more than 5–7% tin in chill-cast ingots containing zinc.—J. H. W.

Density Measurements: A Guide to Quality in Bronze Castings. (Pell-Walpole). See p. 199.

Nickel-Bearing Copper: New High-Conductivity Temper-Hardened Alloy [E.R.M. 3A]. —— (*Metal Ind.*, 1947, **71**, (15), 301).—A high-conductivity copper alloy containing nickel 1·0, phosphorus 0·2, and sulphur 0·2% is said to combine the conductivity of high-conductivity copper, strength approximating to that of gun-metal, the free machinability of brass, the facility to harden other than by cold work after fabrication, the maintenance of hardness, strength at elevated temp., and resistance to corrosion. The alloy is patented under the name of E.R.M. 3A.—J. H. W.

*The Rate of Oxidation of High-Chromium Fe–Cr–Al Alloys. I. I. Kornilov and A. I. Shpikelman (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **53**, (9), 805–808).—[In English]. The rate of oxidation of alloys containing chromium 40, aluminium 2, 4, 7, 8, 10, and 13%, and iron remainder, was measured at 1200° C. by determining the weight loss. The results of oxidation lasting 1000 hr. show that the rate of oxidation decreases with an increasing aluminium content in the alloy, attaining a minimum with an aluminium content of 10–13%. The process of oxidation is followed by a loss in aluminium content of the alloy and an increase in its chromium content.
—V. K.

*The Rate of Oxidation of Austenitic Iron–Chromium–Nickel Alloy. I. I. Kornilov and A. I. Shpikelman (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **54**, (6), 511–517).—[In French]. An alloy containing carbon 0·62, silicon 1·74, chromium 28·19, nickel 26·81, manganese 0·35%, and iron remainder, was oxidized at 1100° and 1200° C. for times up to 750 hr., and subsequently analysed for losses in the alloying elements. The results show that at 1100° C., carbon, silicon, and chromium losses amount to 61·3, 56·9, and 5·5% of their initial values, while at 1200° C., carbon and silicon are reduced by 70·1 and 67·8% and chromium increased by 6·1%. Nickel contents are increased in both cases by 5·5 and 6·8%, respectively. The

change in the oxidation of chromium at higher temp. is explained by the reduction of chromium oxide with silicon.—V. K.

Time-Dependent Phenomena in Iron-Containing Material Subjected to Mechanical and Magnetic Forces. J. L. Snoek (*Schweiz. Arch. angew. Wiss. Techn.*, 1947, **13**, (1), 9–14).—Reprinted from *Physikalischen Gesellschaft, Zürich,* **1946,** (2 May).—J. L. T.

*****The Effect of the Rate of Deformation on the Hardness of Lead–Mercury Alloys.** V. P. Shishokin and N. A. Vikhoreva (*Trudy Leningrad. Politekhn. Inst. im. M. I. Kalinin,* **1946,** (1), 16–22).—[In Russian]. Experiments were carried out on the hardness of lead–mercury alloys containing 0–30% mercury, using a 10-mm.-dia. ball. The temp. and time of loading were varied, and the results plotted against composition. Impact-hardness determinations were also made. For small rates of deformation, max. hardness occurs in the region of 13·5 wt.-% mercury (12·8 at.-%), which corresponds with max. lattice distortion.—N. B. V.

*****On the Equilibria of the System Lead–Silver–Zinc in the Vicinity of the Lead-Rich Binary Eutectic.** Léon Jolivet (*Compt. rend.*, 1947, **224**, (26), 1822–1834).—J. reviews the previously published work on the lead–silver–zinc system from the point of view of the desilverization of lead. He considers that Williams's work (*Proc. Australasian Inst. Min. Met.*, 1925, **58**, 495), although excellent in other respects, contains a serious error due to the oxidation of zinc. To obviate this error, J. determined the curve of the binary eutectic and the composition of the solid phase that separates in its vicinity when molten ternary mixtures less rich in lead are cooled. Under these conditions, a pasty layer of fine crystals surrounded by liquid appear on the surface and cannot be separated. J. determined their composition and that of the liquid in equilibrium with them. The binary eutectic curve incorporating his results has the same form as Williams's, but differs considerably towards the pure-lead end of the diagram. The temp. was held at about 315° C., and it is shown that, in each of five regions corresponding to a silver–zinc compound, there occurs the isothermal dissociation of a solid compound in equilibrium with its constituents in the liquid phase, the compound not forming a solid solution, nor being completely dissolved in the liquid phase. Thus, the desilverization of lead by zinc is caused by the separation of one of the compounds : $AgZn_4$, Ag_2Zn_5, Ag_5Zn_8, $AgZn$, or Ag_3Zn_2, which are formed during cooling at the surface of the silver and zinc dissolved in the lead.—J. H. W.

*****Cast and Extruded Magnesium Alloys.** D. E. Dineen and N. D. Benson (*Metal Ind.*, 1947, **71**, (6), 103–105).—A communication from the British Non-Ferrous Metals Research Association. Impact and tensile tests were carried out on four magnesium alloys, containing : (1) aluminium 8, zinc 0·5, manganese 0·3%, (2) aluminium 9·5, zinc 0·5, manganese 0·3%, (3) zinc 4·5, zirconium 0·7%, (4) zinc 3, zirconium 0·7%, in one or more of the following states : solution treated, fully heat-treated, annealed, as cast, and extruded at room temp. and − 70° C. The impact fracture of the magnesium–zinc–zirconium alloys was of an unusual type, especially in un-notched specimens, appearing as a highly polished fracture in half the specimen and as a tensile fracture in the other half. Little difference was observed between the ultimate tensile strength of the manganese-containing alloys at room temp., but a marked increase in the case of the zirconium-containing alloys at the lower temp. Percentage elongation and reduction in area were in all cases lower at − 70° C., but a useful degree of ductility remained in the zirconium-containing alloys, which also showed better impact resistance. For all the alloys, except (2) in the annealed condition, the impact values of the un-notched specimens were rather lower at − 70° C. than at 20° C.—J. H. W.

*The Alloys of Magnesium and Cobalt. E. M. Cramer, H. P. Nielsen, and F. W. Schonfeld (*Light Metal Age*, 1947, **5**, (9), 6–9).—Density and hardness measurements, thermal analysis, and metallographic and X-ray examination of magnesium–cobalt alloys led to the conclusions that, at a composition of $33\frac{1}{3}$ at.-% cobalt, there is an intermediate phase corresponding to the inter-metallic compound Mg_2Co; a eutectic occurs at 4·5% cobalt and 632° C.; and a peritectic reaction at 689° C., in which Mg_2Co is formed. Solid solu-bility is negligibly small. Cobalt has little effect on the hardness and tensile strength, and the alloys are highly corrodible. The proposed phase diagram for the region studied is given.—M. A. V.

*The Hardness Curve of the Nickel–Copper Alloys. K. A. Ossipov (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **53**, (9), 813–815).—[In English]. The Brinell hardness values of nickel–copper alloys were obtained after a preliminary annealing at 900° C. for 61 hr. Max. hardness results with alloys containing 60 at.-% copper. The fact that the complete filling up of $3d$ band of nickel is reached at the same composition is used to explain the hardness changes obtained.—V. K.

*Heat-Resisting Metals for Gas-Turbine Parts. Howard C. Cross and Ward F. Simmons (*A.S.T.M. Symposium on Materials for Gas Turbines*, **1946**, 3–51; discussion, 121–128).—A summarized report is presented of tests carried out for the American Office of Scientific Research and Develop-ment (NDRC Project NRC-8) by American Brake Shoe Co., Battelle Memorial Institute, Crane Co., Federal Shipbuilding and Drydock Co., Lunken-heimer Co., Massachusetts Institute of Technology, Midvale Co., University of Michigan, National Bureau of Standards, and Research Laboratory, Westinghouse Electric Corpn. Forty-six alloys were tested; classified as (*a*) 18–8 type chromium–nickel–iron, (*b*) 25–16 type nickel–chromium–iron, (*c*) nickel–chromium–cobalt–iron (>15% of nickel, chromium, and iron), (*d*) nickel-base, (*e*) titanium- and aluminium-hardened nickel–chromium and nickel–chromium–iron, (*f*) cobalt–chromium, and (*g*) cobalt–chromium–nickel alloys. Nearly all the alloys had additions of one or more carbide-forming elements (molybdenum, tungsten, columbium, titanium, tantalum), and several contained boron or nitrogen. With one exception, all alloys were wholly austenitic. Values of density, coeff. of thermal expansion, and Charpy impact resistance at 70° and 1500° F. (21° and 804° C.) are tabulated for some of the alloys, and short-time tensile tests at 1000° and 1600° F. (538° and 871° C.) reported for six precision-cast cobalt-base alloys. Stress-rupture tests were made at 1500°, 1600°, and 2000° F. (804°, 871°, and 1093° C.) to determine the stresses required to cause rupture by creep in 100–1000 hr. Complete creep curves were determined at 1350°, 1500°, and 1600° F. (743°, 804°, and 871° C.) to pick out the better alloys and to determine the stresses required to cause creep at 0·0001% per hr. All creep specimens were aged for 50 hr. at the test temp. before loading; and it was later found that some beneficial effects were obtained by ageing at ~150° F. (83° C.) below the test temp. The cobalt–chromium alloys, with one exception, were tested as cast, but most of the other alloys were forged, and these showed the best high-temp. properties when solution treated at 2150°–2300° F. (1177°–1260° C.) and aged at 1350°–1600° F. (743°–871° C.). In stress-rupture tests and creep tests at temp. above 1350° F. (743° C.) the cast cobalt-base alloys showed generally better properties than any of the forged alloys; but design curves prepared using both stress-rupture and creep data for 1500° F. (804° C.) indicate that the forged alloys resist small amounts of deformation (0·2%) better than the cast alloys (which require the greater stress to cause failure by rupture). Relaxation creep tests were made on a few alloys at 1050°–1500° F. (565°–804° C.) to indicate their performance in service in the form of bolts.

—J. C. C.

Gas-Turbine Forgings: Development of High-Creep-Strength Austenitic Steels [and Nimonic 80]. D. A. Oliver and G. T. Harris (*Trans. Inst. Marine Eng.*, 1947, **59**, 79–95; and *Iron and Steel*, 1947, **20**, (7), 333–336; (8), 339–344).—Many new problems have been encountered in the choice of materials for the manufacture of rotor forgings for gas turbines, and a full discussion of these is given. Most of the alloys discussed are highly alloyed steels, but reference is also made to Nimonic 80. O. and H. give comprehensive tables and curves of the results of mechanical tests (tensile, creep, and fatigue), both at room and elevated temp.—D. W. C.

*The Bending Strength of Materials with a Non-Linear Stress–Strain Curve. S. S. Gill (*Aircraft Eng.*, 1947, **19**, (221), 212–216).—G. derives expressions for the position of the neutral axis and the failing moment of resistance of symmetrical and unsymmetrical I-sections and channel sections, angles, solid circular sections, and thick- and thin-walled tubes for materials for which the stress–strain curve is non-linear and is different in tension and compression. Curves are given for D.T.D. 289 alloy from which it is possible to find the position of the neutral axis and the failing bending moment. The curves given for the tubular and solid circular sections may be used for any materials for which the stress–strain characteristics in tension and compression are known.—W. A. M. P.

*The Effect of Notching on Materials of Construction Under Static and Dynamic Tension (Maximum Testing Velocity 29 Feet/Second) [—I, —II]. (Welter). See p. 198.

†Creep: A Review of Recent American Investigations. J. W. Donaldson (*Metal Ind.*, 1946, **69**, (26), 525–528).—Cf. *Met. Abs.*, 1946, **13**, 288, 290, 291. D. gives a summary of six papers presented at the Symposium on the Creep of Non-ferrous Metals and Alloys held by the American Institute of Mining and Metallurgical Engineers. *J. J. Kanter* summarized the application of non-ferrous metals and alloys in stress design and the creep characteristics of such materials. *H. L. Burghoff* and *A. I. Blank* described investigations on the creep characteristics of phosphorized copper. *B. B. Betty, H. L. Eiselstein*, and *F. P. Huston* discussed the creep properties of high-nickel alloys such as cold-drawn, annealed Monel metal and Inconel. *H. C. Montgomery* reviewed the properties of some cast copper-base alloys at elevated temp. *E. H. Kelton* and *B. D. Grissinger* gave creep-test results on well known zinc die-casting alloys, and dealt with the application of these results to engineering design. *A. A. Smith* and *H. E. Howe* described tests on a few antimonial-lead alloys compared with copper-bearing alloys.—J. H. W.

Creep and Some Creep-Resisting Alloys. G. Burns (*Eng. Materials Processes*, 1947, **5**, (19), 123–126).—See *Met Abs.*, this vol., p. 7.—H. A. H.

*Mechanical Strength as an Electron Effect. G.-M. Schwab (*Experientia*, 1946, **2**, (3), 103–105).—[In German]. The catalytic properties of Hume-Rothery alloys in the dehydration of formic acid were studied. A relationship between the catalytic activation energies, electrical resistivities, and Brinell hardnesses of these alloys and the " electron concentration " in them was discovered. A wave-mechanical theory of hardness, based on the more or less total completion of the Brillouin zones is proposed.—F. M.

Influence of Volume Changes During Transformations on the Rate of Formation of Nuclei of the New Phases. N. N. Sirota (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **52**, (2), 151–154).—[In English]. The effect of stresses arising through vol. changes in phase transformations on the rate of nucleation is treated mathematically. An expression is obtained which could be used to estimate such effects, but no confirmatory examples of the accuracy of the formula are given.—V. K.

*Thermomechanical Treatment of Ferromagnetic Materials. F. S. Shur and A. S. Khokhlov (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **53**,

(1), 39–40).—[In English]. S. and K. studied the effect of temp. and magnitude and sign of stress on the changes in magnetic properties of a number of ferromagnetic alloys when cooled under a stress system. The permeability value increases upon cooling of a material with a positive magnetostriction under tension, and of a negative magnetostriction material under compression. The magnitude and the sign of changes in magnetic properties is a function of both temp. and stress system.—V. K.

III.—STRUCTURE

(Metallography ; Macrography ; Crystal Structure.)

[For all abstracts on the constitution of alloy systems, including X-ray studies, see II.—Properties of Alloys.]

*Optical Investigations of the Surface Films on Aluminium. K. Huber and A. Gaugler (*Experientia*, 1947, **3**, (7), 277–278).—[In German]. The double refraction of electrolytically produced oxide films on aluminium is due only to the disperse structure of those films. H. and G. produced such films on single crystals with faces cut parallel to lattice planes by using electrolytes of oxalic, sulphuric, phosphoric, and phosphorous acids. The optical properties showed a strict relationship with the crystallographic orientation of the underlying metal, showing the value of examining the surface layers by polarized light in elucidating the structure of the metal. They also depended on the formation conditions, particularly on the electrolyte used.—F. M.

*Structure of Anodic Films Formed on Aluminium in Oxygen-Gas Discharge. P. D. Dankov and D. V. Ignatov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (3), 235–238).—[In English]. Transmission patterns were obtained from a thin aluminium specimen previously oxidized in a discharge tube. A diffuse ring of the spacing $d/n = 3\cdot23$ Å was obtained in addition to all the standard aluminium lines.—V. K.

*Structure of Cathodic Films Formed on Aluminium in a Gas (Oxygen) Discharge. D. V. Ignatov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (4), 329–332).—[In English]. Further work on the formation and structure of aluminium oxide (cf. preceding abstract) showed that such films are formed faster in the cathode than on the anode of a discharge tube, and that they are of γ'-Al_2O_3 type, with a lattice constant of the cube $a = 3\cdot95$ Å. Dehydration of aluminium hydroxide is thus believed not to be a step in the formation of γ'-Al_2O_3.—V. K.

*Rate of Grain Growth During Recrystallization [in Aluminium Wire]. A. V. Belustin (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **51**, (9), 693–694).—[In English]. The rate of grain growth was measured by holding the specimen in a furnace having a const. temp. gradient, and measuring the rate of the movement of grain boundaries with increasing temp. The results obtained on pure aluminium wire, previously stretched to 2, 3, 4, 5, 6, and 8% elongation, show that the growth rate obeys the exponential law $v = ae^{-b/T}$, except at temp. close to the room temp., where it decreases much more quickly. The activation energy is not affected by the degree of deformation in the studied range.—V. K.

*The Structure of Hard Chromium Deposits on Steel. H. J. Goldschmidt (*Metallurgia*, 1947, **36**, (26), 297–302).—The work of other investigators on the structure of hard chromium plating on steel is reviewed, and the results of an X-ray analysis of a number of chromium-plated steel samples presented. The object was to determine the structural conditions associated with good quality (high wear-resistance). Considerable structural differences were

found; the best type showing an expansion of the matrix lattice to form a metastable linkage with the coating at the interface, the linkage being facilitated by hydrogen occluded in the steel base. It is deduced that the consequent strains increase the hardness. These strains disappear on annealing, and at above 400°–500° C. " good " and " bad " coatings have similar lattices. Maxima of lattice spacing at 150° C., and at 600°–700° C., indicate the release of hydrogen and its transit through the coating, but even after annealing at 800°–1000° C., lattice dimensions were greater than those of pure chromium. There was in all cases a pronounced preferred orientation in the chromium coating. External friction in service partly relieved the strain in the good samples, but not the bad ones, which were merely abraded. The thickness of the coating could be determined by measuring the reduction in intensity of the steel lines in X-ray diffraction photographs.—M. A. V.

*Some Observations on the Occurrence of the " Grain-Boundary Gamma " Phase in a 2%-Beryllium, 0·25%-Cobalt, Copper Alloy. P. J. E. Forsyth (*Metallurgia*, 1947, **36**, (216), 309–312).—Specimens of the alloy, in the annealed and half-hard condition, were examined microscopically after various heat-treatments, to investigate the effect of quenching rate on " discontinuous " precipitation at grain boundaries. The orientation of abutting grains affected the amount of precipitation. There was less precipitation and " grain-boundary gamma " after solution heat-treatment at higher temp., and more rapid quenching. On the other hand, higher precipitation-hardening temp. increased the amount of " grain-boundary gamma ". Cold work before the final hardening markedly diminished the " grain-boundary gamma ". Increased grain-boundary precipitation was found to lead to decreased hardness; this is explicable by the fact that there is less beryllium available for matrix hardening.—M. A. V.

*A Low-Temperature Transformation in Lithium. Charles S. Barrett (*Phys. Rev.*, 1947, [ii], **72**, (3), 245).—A note. X-ray diffraction work shows that on plastic deformation at − 196° C., lithium undergoes a transformation which results in the formation of a face-centred cubic modification with lattice constant $a = 4·41$ Å at − 196° C. The transformation is accompanied by a series of audible clicks, as in the twinning of tin or magnesium, from which it may be concluded that the process takes place by abrupt shear movement in small isolated regions. The face-centred cubic phase disappears fairly rapidly when heated above about − 117° C. The discovery was made by considering C. Zener's theory (*Phys. Rev.*, 1947, **71**, 846; *Met. Abs.*, this vol., p. 148) regarding the instability of body-centred cubic structures under shear stress at low temp., and this theory is discussed.—W. H.-R.

*Structure of Primary Films of Oxide and Bromide on Silver. V. V. Tiapkina and P. D. Dankov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **54**, (5), 415–418).—[In English]. X-ray examinations of oxide films formed on silver specimens used as anodes in a discharge tube, and of bromide films formed on immersion of silver into bromine vapour, showed that the structure of the former is of the cuprite type with a cubic lattice constant ($a = 4·69$ Å), and that the structure of the latter is of the rock-salt type ($a = 5·76$ Å).—V. K.

*Electrode Potentials of the Micro-Components of an Alloy [Zinc–Iron, Copper–Lead, and Zinc–Tin]. A. I. Golubev and G. V. Akimov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (2), 143–146).—[In English]. Electrode potentials between phases existing in the microstructure of various alloys (zinc 98·7, iron 1·25%; copper 79, lead 21%; zinc 50, tin 50%) were measured by using an apparatus which included a microscope especially modified for such measurements. The potential curves for the zinc–iron alloy show that the compound $FeZn_7$ is the cathodic component, and the zinc eutectic the anodic component of a micro-cell formed in a dil. hydrochloric acid solution. The potential varies from the centre towards the

grain boundary of a crystal, the max. potential measured in this case being 5 mV. Similar results were obtained with the other alloys.—V. K.

Recovery and Recrystallization Viewed as Processes of Dissolution and Movement of Dislocations [—**I**, —**II**, —**III**, —**IV**]. W. G. Burgers (*Proc. K. Ned. Akad. Wetensch.*, 1947, **50**, (5), 452–457 ; (6), 595–606 ; (7), 719–730 ; (8), 858–861).—[In English]. [I.—] Experimental facts relating to the dependence of the recovery and recrystallization of cold-worked metals on time and temp. of annealing and on the degree of deformation are brought forward. These show that despite some similarity in the relation connecting the processes with time and temp., they are fundamentally different, and recovery is not simply recrystallization on an invisible scale. Relatively stable "rest values" for the physical properties are reached in recovery-anneals intermediate between the cold-worked and fully annealed ones. [II.—] Metallic crystals have an internal "mosaic" structure consisting of "lattice blocks". Both these and the crystals are separated from one another by transition layers of "dislocated atoms". In deformed structures "dissolution" of dislocations can occur by mutual approach and neutralization. Movement of a series of dislocations may result in an effect equivalent to the growth of one block at the expense of another. [III.—] Displacements of atoms which diminish the stresses in the transition layers without displacing them as a whole are essential for recovery. Displacements of boundary layers as a whole, causing growth of one domain at the expense of another, are essential for recrystallization. After considering several experimental facts in the light of this theory, the rate of crystal growth is discussed. Crystals may grow more rapidly at boundaries where they are favourably orientated with respect to the surrounding ones. They may also grow at different rates, attaining different final sizes, in the same matrix. [IV.—] Stimulation of the growth of "pointed" crystals by surrounding crystals during the recrystallization of aluminium plate is discussed. The increase in rate of nucleation observed recently by Anderson and Mehl during the isothermal recrystallization of aluminium is thereby explained.—F. M.

Precision Comparison of Lattice Constants by Means of a Fraunhofer Arrangement. G. Möllenstedt (*Z. Naturforschung*, 1946, **1**, (10), 564–566).— An improved method of comparing lattice constants, with an accuracy of at least 1%, by electron diffraction is described. In the example, a single crystal of muscovite and a polycrystalline aluminium specimen are inserted side by side, simultaneously, into a magnetically focused electron beam. Spots from the former and rings from the latter are thus produced on the same photographic plate. Comparison of the two enabled the ratio of the b-axis of muscovite to the lattice constant of aluminium to be determined as $2 \cdot 221 + 0 \cdot 002$.—F. M.

*A Solid-State Interpretation of the Structure Near the Limit of the Continuous X-Ray Spectrum. Jesse W. M. Dumond (*Phys. Rev.*, 1947, [ii], **72**, (4), 276–283).—The work of P. Ohlin (*Arkiv. Mat. Astron. Fysik*, 1942, [A], **29**, (3) ; 1944, [A], **31**, (9) ; 1946, [A], **33**, (23)) shows irregularities in the continuous X-ray spectrum isochromate taken at low voltage (3000–5000 V.). D. interprets these as being due to the existence of permitted and excluded energy states above the filled levels of the Fermi conduction electrons in the target. These effects are discussed, and it is concluded from several points of view that in copper there is an excluded energy band about 10 V. above the topmost energy of the conduction electrons. Suggestions are made for further work on the subject.—W. H.-R.

V.—POWDER METALLURGY

Sinter-Alumina. II.—Production, Physical Properties, and Uses. Felix Singer and Hans Thurnauer (*Metallurgia*, 1947, **36**, (216), 313–315).—Cf. *Met. Abs.*, this vol., p. 151. Sinter-alumina is characterized by its high resistance to chemical attack at high temp. The few materials which do attack it are molten lithium ; manganese, iron, and chromium in oxidizing atmospheres ; lead, manganese, iron, and tungsten oxides ; fused fluorides, some silicates, and calcium chloride ; and asbestos. Its valuable physical properties include a m.p. of 2050° C., complete gas-tightness at 1700° C., great hardness, high thermal conductivity, and high electrical resistance. These properties open many fields of application, some of which are described.
—M. A. V.

Sintered Powder Bearings [German Practice]. —— (*Metal Ind.*, 1947, **71**, (15), 309).—A description of the sintering of powder copper–tin–graphite and iron–lead–graphite bearings, as practised at the Oellos Plant in Dortmund.—J. H. W.

Production Processes : Their Influence on Design. XXVII.—Powder Metallurgy. Roger W. Bolz (*Machine Design*, 1947, **19**, (9), 139–146).—Cf. *Met. Abs.*, 1946, **13**, 339. A survey is made of powder metallurgy as a production process. B. deals with the various manufacturing procedures, pointing out how the requirements of different specifications demand differing manufacturing techniques. The presses used for forming powder parts of various sizes are described and the limitations in their use pointed out. Hot pressing often gives parts with a higher density and greater strength, using lower pressures. Carbide parts up to 100 in.^{2} in cross-sectional area, the greatest dimension of which can be 18 in., with a length of 8 in., have been produced by hot pressing. The design of powder-metal parts is discussed, and B. shows how modifications in design are required to produce them successfully. A table gives the main properties of a representative range of powder-metal parts.—D. M. L.

The Application of Powder Metallurgy to Engineering Products. J. A. Judd (*Eng. Materials Processes*, 1946, **4**, (10), 275–279).—Examples illustrating the advantages of powder metallurgy for the fabrication of products which cannot be made by other methods, or which require considerable machining when made by normal methods, are briefly described and discussed. In the latter category, ferrous components are considered in some detail.—H. A. H.

VI.—CORROSION AND RELATED PHENOMENA

Electrolytic Corrosion of Fourdrinier Wire Seams. —— (*Paper Ind. and Paper World*, 1946, **28**, 53–56 ; *C. Abs.*, 1946, **40**, 4335).—Possible causes for the electrolytic corrosion of Fourdrinier wires with silver-soldered seams are discussed. Wires of all-bronze construction are more readily attacked than ones with brass shutes. Failures are greater in the summer than in the winter months. River waters may be a cause, as well as the presence of large quantities of industrial waste materials in the process water. Bleach residues in the pulp will accelerate attack of the brazed seam of the wire. Most cases of corrosion occur with acid waters. Other causes include the type of solder alloy used, the type of metal used for the wire, the nature of the electrolyte, and the temp. and degree of aeration of the water.

***Erosion [of Pump Impeller] Proved by Laboratory Test.** Glen H. Ingels (*Southern Power and Ind.*, 1946, **64**, (6), 61–62; *C. Abs.*, 1946, **40**, 4334).— Chemical analysis and metallographic examination of a worn bronze pump impeller indicated that the metal was substantially unchanged; this fact indicated that the wear was due to erosion rather than corrosion. The solution of the problem is to eliminate foreign matter from the water, use a harder alloy impeller, or reduce the speed of the pump.

Electrochemical Factors in Underground Corrosion of Lead Cable Sheath. V. J. Albano (*Corrosion*, 1947, **3**, (10), 488–498; discussion, 498–500).—The principles of electrochemical corrosion are outlined, and the influences of differences of electrolyte concentration and composition and oxygen concentration discussed. The resistance of lead to soil corrosion depends mainly on the presence of silicates, sulphates, and carbonates in the soil, which form insoluble protective films. The presence of oxygen, organic acids, alkalis, and nitrates, on the other hand, promote corrosion. Corrosion may be prevented by coating the lead with impervious plastic or rubber, by adding film-producing substances to the soil, or by cathodic protection, although in the latter case, if the sheath is too negative to earth, alkalis may be formed with deleterious effect.—M. A. V.

***The Corrosive Action of Water on Lead: Method of Determination of Lead in Water.** Juan A. Raggio (*Rev. Admin. nacl. aguas (Buenos Aires)*, 1946, **10**, 170–177; *C. Abs.*, 1946, **40**, 4648).—The investigation was performed by putting lead foil or plates 7.5×2.5 cm. in 200 ml. of water in a stoppered glass cylinder at $20°$ C. The glass of the cylinder adsorbed some of the lead, which thus escaped determination. This lead could be removed by washing the glass with 50% nitric acid or by adding citric acid or sodium citrate to the water under examination. The lead was determined colorimetrically with dithizone.

Corrosion Processes: The British Contribution to Their Understanding. U. R. Evans (*Metal Ind.*, 1947, **70**, (19), 335–337; (20), 355–357).—E. briefly reviews the historical aspect of the study of corrosion, comments on the various theories put forward by British investigators to account for the phenomenon, and discusses the different forms of corrosion and the methods of testing the resistance of metals and alloys to corrosion. 78 references are given.—J. H. W.

***The Overvoltage of Oxygen Ionization and Its Role in Corrosion Processes.** N. D. Tomashov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (7), 601–604).—[In English]. Changes in the cathode potential were measured for a number of metal cathodes in a solution of $0.5M$-NaCl + $0.005M$-Na_2CO_3 + $0.005M$-NaHCO$_3$ ($pH = 9.1$), in an atmosphere of pure oxygen and under standard energetic stirring. The overvoltage of oxygen is related to the c.d. by a logarithmic law, in the same way as the overvoltage of hydrogen, but the former overvoltage is greater numerically.—V. K.

Cathodic Processes in Metallic Corrosion. N. D. Tomashov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (8), 691–694).—[In English]. The application of various types of polarization curves in the study of corrosion processes is discussed.—V. K.

Controlling Factors in the Corrosion Process. N. D. Tomashov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **52**, (9), 785–788).—[In English]. Quantitative measurement of the rates of corrosion processes on the basis of the polarization curves is discussed.—V. K.

Principles of Immersion and Humidity Testing of Metal Protective Paints. A. C. Elm (*Corrosion*, 1947, **3**, (10), 501–509; discussion, 509–538).—A critical review of test procedure, primarily for painted steel panels.—M. A. V.

Films and Surface Cleanliness. Jay C. Harris (*Metal Finishing*, 1946, **44**, (8), 328–330, 333).—A discussion of the almost-invisible thin coatings or

films which can form on metallic surfaces, and their relation to practical operations. The state of the surface will vary according to the previous treatment : drawing results in striations due to imperfections of the die or inclusions of abrasive particles ; deformation at low temp. and subsequent annealing leads to new crystal growth of nuclei in the disorganized layer ; pickling treatment, polishing, and buffing all affect the state of the surface. Oxide films are the most common ; if they are porous or discontinuous the metal corrodes more easily. Porous metals will include metallic salts after pickling, and corrosion may occur under a protective electroplated layer, or by failure of the coating through pitting. Organic coatings such as lanolin, cholesterol, and hydrolecithin can also be destroyed by included salts and inhibitors. Pickling operations should be carefully controlled.—J. L. T.

VII.—PROTECTION

(Other than by Electrodeposition.)

M.B.V. Process : Application of a Corrosion-Resistant Aluminium Oxide Coating. R. P. Marshall (*Metal Ind.*, 1947, **71**, (5), 93).—The modified Bauer–Vogel process produces an aluminium oxide coating on aluminium and its alloys, which, although not so hard as an anodized coating, is very resistant to corrosion. In this process, the cleaned and degreased parts are immersed in a solution of 0·5–2·5% sodium chromate and 2·5% sodium carbonate at 100° C. for some minutes. For a harder and more stable coating, the parts are further immersed in 5% sodium silicate at 90° C. for 15 min. M. describes a complete plant for working this process and discusses the applications and limitations of the coating.—J. H. W.

Anodizing of Aluminium. —— (*Light Metal Age*, 1947, **5**, (10), 22–24).— A general survey of processes.—M. A. V.

*****Electrochemistry of Protective Films on Metals. II.—Investigation of the Behaviour of Aluminium as Cathode.** E. N. Paleolog and G. V. Akimov (*Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1946, **51**, (8), 609–612).—[In English]. Cf. *Met. Abs.*, 1947, **14**, 106. Cathodic behaviour of oxide films on aluminium was studied by comparing the currents of electrochemical couples in which specimens of aluminium with oxide films of varying thickness and on iron or copper were used as cathodes and zinc or magnesium as anodes. The results show that a large part of the natural protective film is electrochemically inert in solution, anodized surfaces having still fewer active spots.—V. K.

*****Structure of Anodic Films Formed on Aluminium in Oxygen-Gas Discharge.** (Dankov and Ignatov). See p. 186.

*****Structure of Cathodic Films Formed on Aluminium in a Gas (Oxygen) Discharge.** (Ignatov). See p. 186.

Painting Aluminium Alloys. —— (*Metal Ind.*, 1947, **71**, (14), 287).—A description of the simple pre-treatments necessary to the metal surface before the application of paints to aluminium-base alloys.—J. H. W.

Protecting Mill Equipment with Hard Facing [Hastelloy CHF]. G. E. Wilson (*Iron Steel Eng.*, 1946, **23**, (9), 63–66 ; discussion, 66–67).—Examples are given of the use of Hastelloy CHF for hard-facing steel-mill equipment. This is a nickel-base alloy, of Brinell hardness 210 (work-hardening to about 400), non-scaling and heat resisting, with low friction and high tensile strength and ductility ; it may be welded electrically or with oxy-acetylene.

—M. A. V.

Hot-Dip Galvanizing : Analytical Methods for Routine Control. F. F. Pollak and E. F. Pellowe (*Metal Ind.*, 1947, **71**, (8), 143–145).—The authors describe the adaptation of existing methods of analysis of galvanizing liquors for rapid routine control, using standard solutions of such strengths that the calculation of the results is simplified.—J. H. W.

Methods of Formulating Zinc-Yellow Metal Primers. W. F. Spengeman (*Paint Ind. Mag.*, 1946, **61**, 160, 162, 164–166, 169–172, 176–177 ; *Official Digest Federation Paint and Varnish Production Clubs*, 1946, (**256**), 196–207 ; *C. Abs.*, 1946, **40**, 4893).—S. outlines the field of paint technology briefly, discusses the ramifications of the experimental approach to the subject, and summarizes our present knowledge of the role of zinc yellow in this field. Primers are classed as : those for non-ferrous metals, those for ferrous metals in war usage, and those for ferrous metals in non-marine usage.

Metal Spraying : Example of the Flexibility of Sprayed [Zinc] Castings. —— (*Metal Ind.*, 1947, **70**, (19), 345 ; correspondence, (21), 380).—In order to prevent cracking of the lacquer coating of tubular metal chairs, a sprayed zinc coat was interposed between the resilient metal tube and the unyielding lacquer. This sprayed zinc coating also provides an excellent key for the lacquer and effectively protects the iron or steel surface.—J. H. W.

Production Processes : Their Influence on Design. XIX.—Metallizing. Roger W. Bolz (*Machine Design*, 1947, **19**, (1), 105–110).—Cf. *Met. Abs.*, 1946, **13**, 339. The use of the metallizing process for corrosion protection, production of electrical conducting or shielding surfaces, glass- or other non-metallic-soldering, and the building up of wear-resisting surfaces is described, and examples of these uses are illustrated. B. stresses the importance of correct preparation of the surface to be sprayed to ensure satisfactory adhesion of the sprayed layer. Diagrams are given of the best designs for glass–metal seals, and of a sliding boring shaft which has been metallized with bronze. Methods of surface preparation for the spraying of thick wear-resisting coatings are illustrated and described.—D. M. L.

VIII.—ELECTRODEPOSITION

New Spray-Trapping Device [for Chromium Plating]. —— (*Light Metals*, 1947, **10**, (112), 232–233).—A description of the use of tubes of plastic material closed at each end which float in the chromium-plating bath, blanketing it and thereby considerably reducing the escape of fine spray. Without tubes on the surface of the bath, 330 mg. of chromic acid was present in each 10 m.³ of air taken a few inches above the bath over a 30-min. period. With a 2-in. " blanket " of tubes at the surface the corresponding chromic acid figure became 8 mg.—F. A. F.

Roval Dichrome Process [for Zinc-Base Die-Castings]. —— (*Eng. Materials Processes*, 1947, **5**, (17), 58).—Condensed from *Roval Metal Finishing*, **1947**, (Mar.). Operating instructions are given for chromium plating direct on to zinc-base die-castings, using the Dichrome process. The composition of the plating solution is not disclosed.—H. A. H.

Hard Chromium Plating for the Plastics Industry. W. A. Crowder and L. E. Welch (*Indust. Plastics*, 1946, **2**, (1), 16–20, 28–29 ; *C. Abs.*, 1946, **40**, 4299).—A general review. The diagrams given show : (1) hard chromium-plating equipment in plating operation, and (2) the relationship between cathode current efficiency and cathode c.d. for several plating bath temp.; superimposed on the latter curves are the various ranges indicating the nature of the hard chromium deposit as a function of these variables.

*The Structure of Hard Chromium Deposits on Steel. (Goldschmidt). See p. 186.

Corronizing. —— (*Eng. Materials Processes*, 1946, **4**, (13), 393–394).—A process developed by the Standard Steel Spring Co. Steel, brass, or bronze is first nickel plated, followed by electrodeposition of tin or zinc. The coating is then heat-treated at 350° or 700° F., respectively (177° or 371° C.), to improve corrosion-resistance. Salt spray results on nickel–zinc coatings of this type are given.—H. A. H.

Bright Nickel Plating. A. F. Brockington (*Metal Ind.*, 1946, **69**, (23), 468–470; (25), 513–514).—B. discusses the advantages and disadvantages of solutions of the Watts type for obtaining a bright nickel deposit that does not require mopping, and gives particulars of the structure of deposits, types of solution, brightening agents, alloy deposits of cobalt–nickel, and typical bright-plating equipment.—J. H. W.

Blue-Finishing Steel. L. Sanderson (*Eng. Materials Processes*, 1946, **4**, (10), 300–302).—Steel (except stainless) is blued by placing in hot charcoal, immersion in a caustic soda–nitrate solution at 145°–155° C., copper plating followed by a 5-min. dip in 5% copper acetate, or treatment in a molten 50 : 50 $NaNO_3$ and KNO_3 mixture containing MnO_2.—H. A. H.

Electroplating: Modern Uses in the Engineering Industry. W. F. Coxon (*Metal Ind.*, 1947, **71**, (9), 170–172; (13), 264; (17), 347–348).—C. describes electroforming, the production of machinable chrome, the plating of bearings, the deposition of porous chromium on motor-car cylinders and piston rings, and the use of lead–silver–indium bearings. In correspondence, *P. D. Liddiard* emphasizes that, although lead-plated indium alloy bearings stand up to heavy loads, they are otherwise inferior to the Babbitt class of bearings. *David F. Green* considers that L. oversimplifies the problem, and that the case of tin being more effective than indium in the prevention of corrosion of lead applies only to the specific conditions of the test used. C. briefly replies.—J. H. W.

Plating Small Wares. I.—Preliminary Polishing—Degreasing—Scale Removal. II.—Brassing—Barrel and Basket Plating—Barrel Finishing. R. McNair (*Metal Ind.*, 1947, **70**, (23), 423–425; (25), 464–466).—The author describes the finishing of small articles by barrel polishing and barrel plating, in particular, the type of equipment available, the abrasive media, the preparation of the work, methods of scale removal, and the barrel polishing of cast iron, steel, and small brass die-castings.—J. H. W.

†Anodes. I.—Characteristics—Solubility and Shape—Casting. II.—Cast, Rolled, Electrodeposited, and Extruded Copper. III.—Cast and Rolled 70 : 30 and 80 : 20 Brass. IV.—Operating Factors Involved in the Utilization of Gold. V.—Zinc–Cadmium–Tin–Lead. VI.—Operating Factors Involved in the Utilization of Chromium. VII.—Rolled, Forged, and Sintered Nickel Alloys. E. R. Thews (*Metal Ind.*, 1947, **71**, (5), 91–92; (7), 126–128; (11), 225–226; (13), 268–269; (15), 307–309; (17), 343–344; (19), 388–389).—In considering the adaption of the chemical and physical properties of electrolytic anodes to prevailing requirements, T. discusses the use of insoluble and cast anodes, the anode shape and characteristics, and degree of solubility; cast, rolled, extruded, and electrodeposited copper anodes, the cyanide control of the electrolytes, and cathodic polarization; the physical state of brass anodes, the effect of zinc content, and methods of fault determination; the use of gold; obviating the excessive solubility of pure zinc anodes, the effect of alloying additions to cadmium anodes, and the use of tin and lead anodes; the reasons for the exclusive use of insoluble anodes in chromium-plating processes, and the method of utilizing chromium metal by alloying it with other insoluble metals; and the operating factors involved in the fabrication and uses of sand-cast, chill-cast, rolled, forged, and sintered nickel anodes.—J. H. W.

Electroforming : Piece-Part `Production by Electrodeposition. E. A. Ollard (*Metal Ind.*, 1947, **70**, (1), 6–8 ; (3), 51–53 ; (5), 86–88 ; (7), 126–128).—O. reviews the whole process of the reproduction of articles by electroforming, including moulding materials, types of mould, conducting surfaces, connections, coverings, types of metal, and solution formulæ.—J. H. W.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

Electrolytic Production of Aluminium. —— (*Electrician*, 1947, **139**, (16), 1144–1145).—A brief description is given of the power plant at the Resolven works of the South Wales Aluminium Co., Ltd. The normal steady current load of the electrolytic cells is 32,000 amp.—D. M. L.

*On the Current Efficiency in the Electrolytic Production of Magnesium. A. I. Zhurin and O. G. Desyatnikov (*Trudy Leningrad. Politekhn. Inst. im. M.I. Kalinin*, **1946**, (1), 297–304).—[In Russian]. The effect of the concentration of $MgCl_2$ upon the current efficiency in the electrolytic production of magnesium from fused chlorides, has been studied. Cathode current efficiency is shown to be a max. when the concentration is 15–20%.—N. B. V.

*Overvoltage and " Undervoltage " in Electrolysis. Case of Oxygen. N. Vasilesco-Karpen (*Compt. rend.*, 1946, **222**, 644–646 ; *C. Abs.*, 1946, **40**, 4301).—A double voltmeter is considered. It consists of platinized platinum and gold anodes with a common cathode ; the electrolyte is dil. sulphuric acid containing oxygen at atmospheric pressure. The e.m.f. between the anodes and the electrolyte, and the oxygen overvoltage at the gold anode are represented by formulæ analogous to those for hydrogen. From these, V.-K. concludes that a greater e.m.f. is required to pass a given, very small current through a platinized platinum anode than through a gold anode. A numerical verification can be made, when it becomes possible to measure overvoltage for currents between 1 and 5 m.amp./cm.² (" Undervoltage " is the voltage below the platinum electrode voltage but above the theoretical 1·234 V.).

XI.—ANALYSIS

*The Determination of Zinc in Metallic Cobalt by Dithizone. R. S. Young (*Metallurgia*, 1947, **36**, (216), 347–348).—In the method described, the Zn is estimated volumetrically by measuring the quantity of dithizone required to extract it. The method is rapid and accurate in the range 0·005–0·05% Zn.
—M. A. V.

*Lead in Zinc Alloys : Routine Determination to Fine Limits. F. L. Jameson (*Metal Ind.*, 1947, **70**, (16), 272).—The following is an outline of a method for determining Pb in alloys of the Mazak type : Cautiously dissolve the alloy in strong HCl, dilute, and filter. Clean the filter paper with HNO_3 and complete solution with HCl. Evaporate to fumes with H_2SO_4, boil with water, and settle overnight. Filter off PbS, wash with H_2SO_4, and dissolve in ammonium acetate. Precipitate the Pb from the boiling solution with a saturated solution of $K_2Cr_2O_7$ and settle. Filter hot through a Gooch crucible, wash thoroughly, and treat with acidulated NaCl solution. To the solution add KI and starch, and titrate with $N/50 \cdot Na_2S_2O_3$.—J. H. W.

Hot-Dip Galvanizing: Analytical Methods for Routine Control. (Pollak and Pellowe). See p. 192.

Super-Purity Aluminium: Analysis by Photo-Electric Colorimetric Methods. P. Urech (*Metal Ind.*, 1947, **70**, (18), 303–304).—U. discusses the precautions to be taken in the colorimetric determination of the impurities in Al of purity of the order of 99·99%, and describes the standard method of analysis for the Fe, Si, and Cu contents, as practised in France.—J. H. W.

*****Some Applications of Inorganic Chromatography [—I].** G. Robinson (*Metallurgia*, 1947, **37**, (217), 45–47).—The use of chromatographic methods for the micro-analysis of alloys is discussed, and a method described by which Zn may be determined in a brazing alloy, using 8-hydroxyquinoline as a chromatographic adsorbent for Zn, Cu, and Ni. The Zn complex is distinguishable by its fluorescence in ultra-violet light.—M. A. V.

Polarographic Determination of Lead in Aluminium Alloys. William Stross (*Metallurgia*, 1947, **37**, (217), 49–51).—Cf. *Met. Abs.*, this vol., p. 51. The method is based on one previously described by Kolthoff and Matsuyama. The metal is attacked with HCl; Sn is oxidized with $KClO_3$; and Fe is reduced and Cu precipitated with NH_2OH and KCNS. An anode of Ag wire is recommended.—M. A. V.

*****A Spectrographic Method for Determination of Small Amounts of Dissolved Copper and Lead.** P. M. Heertjes (*Chem. Weekbl.*, 1946, **42**, 91–95; *C. Abs.*, 1946, **40**, 4314).—Cu is determined with a solution of dithizone (diphenylthiocarbazone) in CCl_4 of known strength at pH 0·5–1·0 until all Cu is removed. The absorption spectrum of the combined extracts is examined between 450–590 mμ and 500–530 mμ. The Cu content can be determined with the aid of an empirical graph. The theory is discussed in some detail. For determining Pb, the solution is made ammoniacal and shaken with dithizone solution in CCl_4 until the latter is colourless, the Pb compound being in the aqueous phase. Again the Pb concentration is determined by the absorption spectrum. The accuracy of the method is given as 0·1 γ Cu, 33 γ Pb in 25 c.c.

*****The Spectrographic Analysis of Uranium.** K. B. Mather (*J. Proc. Roy. Soc. N.S.W.*, 1946, **80**, (3), 187–195).—The most persistent lines of the U arc spectrum and the probable interfering lines due to Fe and other impurities in ores have been determined. 10^{-3} mg. of U can be detected by taking light from the cathode layer. Chemical and Geiger methods are thus more sensitive. The ultimate accuracy is probably about $\pm 2\%$ of the U content over the range 0·1–10% of U, under favourable conditions. It is concluded, therefore, that spectrographic analysis is adequate and more rapid than chemical analysis in the preliminary survey of an ore field, but for the accurate analysis of promising ore types chemical analysis is unquestionably more suitable.—F. M.

High-Purity Materials: Spectrographically Standardized Substances Now Available. —— (*Metal Ind.*, 1947, **70**, (15), 248).—Pure metals are important as reference standards in spectrography and also in research on chemical and metallurgical problems. The range of standards available at Johnson, Matthey and Company, Ltd., is described.—J. L. T.

The Spectrograph: Its Use in the Analysis of Metals and Ores. T. C. McBurney (*Western Metals*, 1946, **4**, (5), 32–35; *C. Abs.*, 1946, **40**, 4262).—A description of a grating spectrograph, equipped with both arc and spark, and directions for its use. M. states that the high-potential spark is best adapted to the quantitative analysis of metals and alloys, such as Al, Zn, and steel, where the sample is of the proper size and shape to be machined or ground to a smooth even surface on one side. The most desirable form is a 2-in. disc about 1 in. thick. It forms one electrode with carbon for the other. For qualitative analysis, where great sensitivity is desired, the arc is best. Methods of sampling are discussed.

*****An Electrical Apparatus for Light Emission in Spectrum Analysis [Emitator].** C. Georg Carlsson and Roland Rynninger (*Jernkontorets Ann.*, 1947, **131**, (1), 1–23).—A survey of the usual types of spark and controlled-

arc sources is given which makes clearer the relationship between the arc and spark characteristics. The authors have collaborated in the design of a Swedish-made universal source unit, called the Emitator. This comprises a high-tension unit to give controlled sparks from a 2-kW., 15-kV. transformer with a rotary interrupter, a series spark gap, variable inductance and resistance in the discharge circuit, and a large inductance which can be shunted across the analysis gap. The controlled-arc or low-tension portion is of the type in which a large capacitance (up to 192 μF.) is discharged across the gap by a trigger circuit, which is non-inductively coupled into the discharge circuit through a rotary interrupter. The primary circuits of both the main and trigger circuits have relays to operate them 50 or 100 times per min. A.C. and D.C. supply at 220 V. are both required; for higher power on the low-tension circuit the Emitator can be operated by A.C. only, using a step-up transformer and a rectifier to charge the main condenser.—E. VAN S.

Qualitative Microchemical Analysis by Microradiography with Fluorescent Screen. A. Engström (*Experientia*, 1947, **3**, (5), 208–209).—[In English]. The use of a fluorescent screen is recommended in place of the usual photographic technique of microradiography for the routine examination of metallurgical samples. This method permits of a direct qualitative analysis of an inclusion in an alloy by adjusting the voltage of the X-ray tube so that the wave-length of the beam is on the long side of the *K*-absorption edge of the sought-for element. If the voltage is then increased, the inclusion will cast a shadow on the screen if it contains that element.—F. M.

XII.—LABORATORY APPARATUS, INSTRUMENTS, &c.

(See also " Testing " and " Temperature Measurement and Control ".)

Continuous Recording Dilatometer. —— (*Machine Design*, 1947, **19**, (2), 153–154).—A brief description is given of the instrument developed by Sylvania Electric Products, Inc., of New York, to provide continuous readings of thermal expansion of metals and ceramics. The specimen is heated in an inert atmosphere. An illustration of the apparatus is given and diagrams show the electrical circuits and method of locating the specimen in the quartz tubes.—D. M. L.

The Physical Society's Exhibition of Scientific Instruments and Apparatus. —— (*Eng. Materials Processes*, 1947, **5**, (19), 109–122).—Cf. *Met. Abs.*, this vol., pp. 22–23.—H. A. H.

A New Electron Microscope with Continuously Variable Magnification. J. B. le Poole (*Philips Tech. Rev.*, 1947, **9**, (2), 33–64).—The first of a series of articles on electron microscopy. The characteristics of the ordinary optical microscope are reviewed, and the great increase in magnification obtainable by the use of electron beams is described. After an outline of the principles of the electron microscope, a description is given of the instrument in use at the Institute for Electron Microscopy at Delft. Resolving power is 25 Å, and the magnification is continuously variable from × 1000 to × 80,000. It is also possible to obtain electron-diffraction patterns of parts of specimens which have been studied electron-optically. The applications of the electron microscope are discussed at some length.—D. M. L.

High-Temperature Furnace for Electron-Diffraction Studies. Earl A. Gulbransen (*Rev. Sci. Instruments*, 1947, **18**, (8), 546–550).—A furnace is described for the study of surface phenomena occurring up to 1000° C., by means of electron-diffraction methods. The specimens are mounted in the face of a 25%-chromium, 12%-nickel alloy-steel cylinder heated internally by means of a tungsten heating element mounted on a beryllia support and

operated in a hydrogen atmosphere. The whole furnace assembly is about $1\frac{1}{4}$ in. dia. and requires about 500 W. input for max. temp. with the arrangement of radiation shields used. Three specimens are mounted in the block, two for diffraction experiments, the third being a blank for temp.-control purposes. Suitable provision for the necessary manipulation (translatory motion perpendicular to the beam, and rotary motion to insert specimens into the beam alternately) is made by means of a Wilson seal.—S. M.

High-Temperature X-Ray Diffraction Apparatus. L. S. Birks and H. Friedman (*Rev. Sci. Instruments*, 1947, **18**, (8), 567–580).—B. and F. describe a high-temp. oven for use with an X-ray spectrometer of the Geiger-counter type. This method of recording was chosen in preference to the photographic method by virtue of its greater speed (about 5°/min.). The heating is accomplished by a hot-plate-type heater, consisting of a tungsten element embedded in beryllia, the whole being protected by a polished tantalum case. This assembly in turn is surrounded by radiation shields, the outer one of which is gas-tight and carries beryllium windows. Automatic temp. control is employed. Either sheet specimens or powder specimens carried on platinum gauze are used. The hot plate is about 2 in. square and requires 250 W. input for 1500° C.—S. M.

The Electron-Diffraction Camera [Details of Its Construction]. —— (*Eng. Materials Processes*, 1947, **5**, (18), 97–99).—A general description of the camera and high-tension unit.—H. A. H.

XIII.—PHYSICAL AND MECHANICAL TESTING, INSPECTION, AND RADIOLOGY

Factors Affecting the Technical Hardness of Magnesium. Louis A. Carapella and William E. Shaw (*Light Metal Age*, 1947, **5**, (7), 8–10).—The Brinell hardness test is considered with special reference to extruded magnesium rod. Recommendations are made for the manner of carrying out the test with a 10-mm. ball indentor.—M. A. V.

Portable Hardness Tester [Penetrascope]. —— (*Aircraft Prodn.*, 1947, **9**, (105), 277).—A description of a portable diamond hardness tester, the Warman Penetrascope. This instrument weighs only $7\frac{1}{2}$ lb. and is capable of covering the entire metallurgical hardness range : tests may be carried out in any position and the indenting load can be varied from 5 to 30 kg. by a single control screw.—W. A. M. P.

A Non-Destructive Magnetic Hardness Tester. W. H. Meiklejohn (*Electronic Ind. and Instrumentation*, 1947, **1**, (10), 14–15, 45).—The instrument described has been developed by the General Electric Company of the U.S.A., for the hardness testing of the small steel pivots used in electrical and other instruments. The size of the parts to be tested varies between $\frac{1}{16}$ and $\frac{1}{2}$ in. long. Hardness can be measured to ± 2 points on the Rockwell C scale. The operation of the tester depends on the different magnetic properties of the various iron modifications. The part to be tested is made to stand vertically on a brass anvil by means of an Alnico magnet fixed above it, when its behaviour is compared with that of a standard of satisfactory hardness. The theory of the tester is discussed.—D. M. L.

Measuring Micro-Hardness by Indentation Tests. E. S. Greiner (*Bell Lab. Record*, 1947, **25**, (3), 104–107).—The Vickers and Knoop micro-hardness tests are discussed. Illustrations given show very clearly the difference in the shape of the diamond indentors and the indentations produced by them.
—D. M. L.

Micro-Hardness Testing. ` Edwin Gregory (*Eng. Materials Processes*, 1947, **5**, (18), 75–76).—Cf. *Met. Abs.*, 1946, **13**, 429. The apparatus and technique developed by E. B. Bergsman (Axel Lundqvist A-B, Stockholm, 1945) is described.—H. A. H.

*The Effect of Notching on Materials of Construction Under Static and Dynamic Tension (Maximum Testing Velocity 29 Feet/Second) [—II, —III]. Georges Welter (*Metallurgia*, 1947, **36**, (216), 339–343 ; **37**, (217), 36–40).—Cf. *Met. Abs.*, this vol., p. 160. [II.—] Unpublished results of a previous investigation are reported ; they include tests on Duralumin, brass, cold-drawn copper, and zinc. These showed a greater max. strength and elongation with dynamic loading. A " V " notch of wide angle increased both static and dynamic strengths ; a sharp rectangular " U " notch led to still further increases. Sharp-notched specimens of both brass and Duralumin, under high-speed impact load, had a 40% lower resistance than a dynamically loaded cylindrical specimen. The new tests carried out confirmed that with cylindrical specimens the strength of all materials tested increased with speed of loading, with the exception of zinc, when the strength begins to fall slowly above loading speeds of 20 ft./sec. Static tests on notched specimens of soft metals showed an increase in static strength with increase of sharpness of the notch. On the other hand, sharp " U "-notched specimens had much lower dynamic strength than other shapes. [III.—] A series of tests on 16 different alloys (of different heat-treatments) showed an increase of dynamic strength with striking velocity in most cases (up to 16·68 ft./sec.), with a corresponding increase in elongation. With drawn aluminium, a " V " notch of 160° on the specimen increased the static strength, but the dynamic strength fell rapidly at speeds over 16·68 ft./sec. Similar results were obtained with 90° " V " notches, and with sharp " U " notches. Annealed aluminium behaved correspondingly, and also aluminium alloy 17S·T, which also had a very low dynamic strength in un-notched specimens at 16·68 ft./sec. Brass and magnesium alloys resisted higher dynamic than static loads, but were very sensitive to notches. Cylindrical specimens of zinc had the highest strength ratio of any material tested (2·9 at 16·68 ft./sec.). Monel metal showed practically no notch sensitivity, and a sharp " U "-notched specimen withstood the heaviest load of 2200 lb. Further series of tests carried out to determine the effect of gauge length showed no significant differences from the results already reported.—M. A. V.

Fatigue-Testing Machine. B. J. Lazan (*Machine Design*, 1947, **19**, (5), 123–127).—L. describes the essentials of machines for fatigue testing and of the various components for adapting the machines for the different types of tests. A machine, known as a below-resonance, centrifugal-force type with inertia-force compensation, is then described. Schematic drawings of the apparatus are given and a number of illustrations of test-pieces in position. An analysis of the inertia-force compensator is presented as an appendix.

—D. M. L.

The Significance of Mechanical Testing. H. G. Davies and J. McKeown (*Metallurgia*, 1947, **37**, (217), 19–22).—A discussion of the information to be derived from the results of conventional mechanical tests, and the limitations of such tests. Particular reference is made to the Izod test and creep and fatigue testing. Gunther and Schmid's work is quoted, with the conclusion that, above a critical temp., the life of a material is determined not by the creep strength, but by the fatigue strength at zero or low mean stress. The effect of speed on fatigue tests on lead is noted ; reducing the speed reduced the number of reversals to failure.—M. A. V.

The Amsler High-Frequency Vibrophore. ——— (*Aircraft Eng.*, 1947, **19**, (220), 206–207).—The construction and use of the Amsler High-Frequency Vibrophore is described. This instrument can be used for the fatigue testing of metallic and non-metallic materials (ceramics, plastics, &c.) and for investi-

gating the resistance to dynamic forces of structures such as riveted or welded joints and threaded sections; the Vibrophore can also be used for the quantitative determination of the damping capacity of materials. The machine operates on the resonance principle, and the operator is not restricted to one standard size of test-piece or specimen, as the magnitude of the natural frequency of the vibrating elements is dependent on the size and mechanical properties of the specimen and on the weight of the oscillating masses, and can be changed conveniently within wide limits by the addition or removal of weight discs, thus causing an alteration in the main mass. Additional equipment can be obtained for use in conjunction with the machine to carry out tests at elevated and sub-normal temp.—W. A. M. P.

Brittle-Lacquer Stress Analysis.—I, —II. E. Barber (*Eng. Materials Processes*, 1947, **5**, (17), 59–61; (18), 87–89).—[I.—] The advantages, method of use, sensitivity, and applications of the brittle-lacquer method of stress analysis are discussed. [II.—] The importance of careful surface preparation, lacquer film thickness, and rigid control of the drying conditions is emphasized. Additional applications include tensile and compression pre-stress determinations and the dynamic testing of moving parts.—H. A. H.

*The Bending Strength of Materials with a Non-Linear Stress–Strain Curve. (Gill). See p. 185.

Density Measurements : A Guide to Quality in Bronze Castings. W. T. Pell-Walpole (*Metal Ind.*, 1947, **70**, (7), 123–125; (12), 186; (16), 272–273; (18), 304; (21), 380).—P.-W. claims that, provided that certain essential precautions are observed, the use of density measurements for the routine control of quality in batches of bronze ingots of the same size and form is simple and reliable. The measurements should not be considered alone as a guide to pressure tightness. In correspondence, P.-W. justifies his use of uncorrected apparent density values and experimentally determined standard densities. *Thomas B. Crow* suggests that the method requires too many stipulations and doubtful assumptions. *O. R. J. Lee* considers P.-W.'s formula for max. cast density to be misleading. P.-W. replies to C.'s criticisms.—J. H. W.

Sorting Metals Magnetically. H. Sanders (*Eng. Materials Processes*, 1946, **4**, (12), 358–360).—Details and a diagram of the detector circuit of a magnetic comparator are given.—H. A. H.

Supersonic-Wave Penetration Into Materials. Benson Carlin (*Product Eng.*, 1947, **18**, (10), 169).—Reference book sheet.—J. L. T.

Non-Destructive Methods for Determining Metal Plate Thickness. J. G. Kerley (*Corrosion*, 1947, **3**, (10), 467–481).—K. gives brief descriptions of methods based on ultrasonic vibration, thermal conductivity, magnetism, electrical resistivity, electromagnetic induction, and X-rays or gamma-rays. The characteristics of a few representative commercial thickness gauges are tabulated.—M. A. V.

Copper Alloy Sand Castings : New British Standards Code for Inspection Procedure. —— (*Metal Ind.*, 1947, **70**, (17), 291, 293).—A summary of British Standard Specification No. 1367, 1947 : "Code of Procedure in Inspection of Copper-Base Alloy Sand Castings."—J. H. W.

Crack Inspection. F. W. Giles (*Eng. Materials Processes*, 1946, **4**, (13), 389–393).—See *Met. Abs.*, 1947, **14**, 22.—H. A. H.

Welding Inspection. A. Warren-Smith (*Welder*, 1946, **15**, (87), 18–21; and *Eng. Materials Processes*, 1946, **4**, (13), 397–401).—H. A. H.

RADIOLOGY

*X-Ray Measurement of the Thickness of Silver Plating. R. B. Gray (*Phys. Rev.*, 1946, [ii], **69**, (1/2), 49).—A summary of a paper presented to the American Physical Society. The thickness of a plated metal layer can be

determined by comparing the intensities of the back-reflection lines of the base metal and the plated metal. The intensity ratio is expressed mathematically. A photograph of silver-plated brass was made using iron $K\alpha$ radiation. The 311 planes were found to be most suitable for comparison. The X-ray method indicated a thickness of $2 \cdot 2$ μ. Chemical stripping of the whole piece indicated a thickness of $3 \cdot 3$ μ. This difference is due to the extra build-up which occurs at the corners of plated pieces.—AUTHOR.

***Thickness Measurements of Thin Coatings by X-Ray Absorption.** L. S. Birks and H. Friedman (*Phys. Rev.*, 1946, [ii], **69**, (1/2), 49).—A summary of a paper presented to the American Physical Society. An X-ray absorption method was applied to the measurement of thin films on thick crystalline or polycrystalline backings. Characteristic X-rays were reflected from the base material at one of the Bragg diffraction angles, and the diffracted intensity measured by a Geiger-counter system. When the base material was covered with a thin coating, the X-rays were reduced in intensity according to the exponential absorption law for the coating material. From the measured ratio of intensities for the coated and uncoated backing, the geometry of the arrangement, and the known absorption coeff. for the coating, it was possible to compute the thickness of the coating. Measurements were made with a powder diffraction spectrometer, utilizing the focusing principle. The area of specimen covered by the X-ray beam was varied between 1 cm.² and 1 mm.² Metal-plating thicknesses were determined in the range 10^{-5} to 10^{-2} cm. The method is generally applicable to coatings of any material or combination of materials whose X-ray absorption coeff. are known.—AUTHOR.

†**Gamma-Ray Radiography for Inspection Work : A Comparison with X-Ray Technique.** J. C. Chaston (*Aircraft Prodn.*, 1947, **9**, (106), 309–311).—C. discusses the use of gamma-ray radiography for inspection work and compares the necessary technique with X-ray technique. Source of gamma-radiation is a radium salt sealed in a thin-walled platinum container. The radium salt slowly decays, emitting α-rays with the subsequent formation of radon gas. Disintegration of the radon with subsequent emission of gamma-rays is briefly described, and some of the outstanding characteristics of gamma-rays—scatter, penetrating power, and photographic contrast—are dealt with in some detail. Contrast between flaws and sound metal is less with gamma-rays than with medium-voltage X-rays, but a much wider range of sections can be examined with a single exposure. Important advantages of radiography by gamma-rays are the extreme compactness and portability of the apparatus, the deep penetration obtained, and the clear definition over the whole field of the negative. The construction and use of the radium bomb containing the radium salt is fully described, and practical advice is given on routine inspection work.—W. A. M. P.

An Improved Process-Inspection Method [Use of X-Rays]. A. G. Arend (*Paint Technol.*, 1947, **12**, (133), 10).—A very general description of an improved portable X-ray apparatus. It is claimed that exposures of the order of one-millionth of a second can be made.—H. A. H.

Film-Blackening Method for the Measurement of Relative X-Ray Intensities. Donald T. O'Connor (*Indust. Radiography Non-Destructive Test.*, 1947, **6**, (1), 40–43).—A review of the effects of the following factors on the density : exposure relationship for photographic films : (*a*) characteristics of the film, (*b*) type of exposure holder, (*c*) developer composition, (*d*) developer temp., (*e*) duration of development, (*f*) reciprocity law, (*g*) base fog density. It is concluded that accurate comparative, but not absolute, measurements of X-ray intensities may be made by the film method.—L. M.

XV.—FOUNDRY PRACTICE AND APPLIANCES

New Strong Aluminium Casting Alloy [Almag 35 and 55]. Harold Knight (*Materials and Methods*, 1947, **25**, (1), 68–71).—" Almag 55 " is an aluminium alloy containing magnesium 11·2, boron 0·4, beryllium 0·2, silicon, iron, and copper each $< 0·2$, other impurities $< 0·1\%$, and has a tensile strength of $\sim 55,000$ lb./in.^{2} as cast. It ages slowly at room temp., the strength increasing to $\sim 64,000$ lb./in.^{2} after 6 months. The alloy is melted in a clay–graphite crucible and treated by blowing boron chloride through the molten metal before pouring. Alloy " Almag 35 " (" for strength ") contains magnesium 6, boron 0·4, beryllium 0·1%, or (" for high finish ") magnesium 4, boron 0·4, beryllium 0·1%, and has a tensile strength of $> 35,000$ lb./in.^{2}—J. C. C.

Gas Porosity in Aluminium Alloys—How to Avoid It. Hiram Brown (*Light Metal Age*, 1947, **5**, (1), 16–19).—Porosity of cast aluminium alloys is due mainly to hydrogen liberation during solidification ; the various sources of hydrogen pick-up are discussed. Dry salt fluxes are useful in preventing gassing, but degassing by nitrogen or chlorine is generally necessary. Chlorine is preferable in severe cases.—M. A. V.

*Pinhole Porosity : Investigations with Aluminium Alloy Castings. C. C. Griffin and L. G. Stephens (*Metal Ind.*, 1947, **71**, (7), 123–125 ; (8), 150–152).— G. and S. investigated the causes and remedies of pin-hole porosity in aluminium alloy castings. They found : (1) that water vapour, from whatever source, is the main cause of this defect, (2) that it can be minimized by ensuring that fan-air intake and oil-storage tanks are protected from rain and by the use of crucibles for casting, (3) that the use of a flux that dissolves the aluminium oxide skin and so allows the excess hydrogen to escape is a clean and convenient method of ensuring gas-free metal, even under melting conditions otherwise favouring severe porosity.—J. H. W.

Quotation for Aluminium Alloy Castings. E. Carrington (*Light Metals*, 1946, **9**, (96), 43–48).

Quoting for Aluminium Alloy Castings. E. Carrington (*Metallurgia*, 1947, **37**, (217), 31–35).—A costing system is suggested, to enable foundries to make equitable quotations for aluminium alloy castings. A specimen quotation sheet is included.—M. A. V.

Light-Alloy Castings. J. A. Oates (*Aircraft Prodn.*, 1947, **9**, (104), 218– 223).—O. deals with the production casting and machining of aircraft pistons and certain other components by Wellworthy Piston Rings, Ltd. The foundry organization is subdivided into four groups : (1) sand foundry, (2) semi-die-gravity foundry, (3) gravity-die foundry, and (4) mechanized die-casting. Sands in const. use are Southampton Yellow and Mansfield Red, and a practical account is given of the work in the four departments referred to above. A fully mechanized low-pressure die-casting process for the production of a top half of a junk-head in " Y " alloy is described in some detail. Foundry procedure, die preparation, quality control, heat-treatment, machining, and inspection are all briefly discussed. Extremely thorough and carefully documented material control at all stages is an important feature of the casting process.—W. A. M. P.

Bearing Alloys and Manufacturing Technique. M. H. W. Gall (*Eng. Materials Processes*, 1946, **4**, (14), 422–430).—For ease of manufacture and replacement in service, bearing alloys are frequently bonded to steel or bronze bearing shells. Correct machining and cleaning of the shells is discussed. For casting tin-base alloys, steel shells are tinned using two pure tin baths : (a) 270°–350° C., (b) 250° C. ; 80 : 20 lead–tin alloy may be substituted for lead bearing alloys. For cadmium–nickel alloys, the alloys themselves are used in the bonding pot. Lead bronzes and copper–lead alloys require a

heat-treatment process, inducing diffusion. Temp. (250°–270° C.) and short immersion time are important when tinning bronze shells. The advantages, composition, and casting of white metal are briefly discussed. The most successful cadmium–nickel alloy is cadmium 98·7, nickel 1·3%. The corrosive attack of some sump oils is overcome by the use of an indium coating, followed by heat-treatment. The compositions and casting techniques for copper–lead alloy and lead bronze are critically discussed. Sintered bronze is largely copper powder + approx. 10% tin (with or without graphite), pressure moulded and sintered. Lead-base alloys and Hiduminium alloys are surveyed. Methods of process inspection to test the strength of the bond are briefly mentioned.—H. A. H.

Bronze Founding—A Review of Some Recent Developments. Frank Hudson (*Metallurgia*, 1947, **36**, (216), 303–308).—H. divides recent developments into two main categories : alloying and melting methods, and pouring, moulding, and feeding methods. The former group includes the work of Baker and his collaborators and of Sieverts on the solubility of hydrogen in copper-base alloys, researches on the degassing of bronzes by Baker and Child and by Pell-Walpole, and the Birlec lift-coil induction furnace. In the latter category are Pell-Walpole's work on casting on to metal cores, Taylor and Rominski's method of atmospheric feeding, Jazwinski and Finch's gas-pressure feeding methods, the use of necked risers, with gypsum sleeves and graphite or " Thermotomic " discs, and fundamental researches by the British Non-Ferrous Metals Research Association and by Pell-Walpole on the effects of moisture in sand moulds.—M. A. V.

Hydrogen in Magnesium Alloys : A Contributory Cause of Microporosity. —— (*Metal Ind.*, 1947, **70**, (8/9/10), 153).—The work of W. A. Baker in this country and of R. S. Busk and E. G. Bobalek in the U.S.A., is reviewed. They showed that significant amounts of hydrogen may dissolve in molten magnesium and may be a contributory cause of microporosity.—J. H. W.

Furnace Combustion : Factors in Crucible Melting. A. C. Schmid (*Metal Ind.*, 1947, **70**, (18), 305–306).—See *Met. Abs.*, 1947, **14**, 224.—J. H. W.

Reverberatory Furnace : Oil-Fired—Low Consumption—Low Metal Loss. —— (*Metal Ind.*, 1947, **70**, (24), 440).—A description of the use of a ½-ton reverberatory-type furnace for the melting of aluminium alloys.—J. H. W.

Melting and Forging of Metals with Induction Heating. J. Max Lee (*Western Metals*, 1946, **4**, (4), 29–30 ; *C. Abs.*, 1946, **40**, 3985).

Foundry Control : Modern Methods of Ensuring Consistent Products. W. A. Baker (*Metal Ind.*, 1946, **69**, (25), 505–507 ; (26), 530–532).—A paper read before the Manchester Metallurgical Society. B. describes the modern methods of ensuring a consistent product in the foundry and reviews the various operations involved in the production of a casting, from the drawing board to the finished article, and their place in the scheme of control.

—J. H. W.

Non-Ferrous Foundry Practice : A Review of Recent Advancements. W. G. Mochrie (*Metal Ind.*, 1947, **71**, (10), 203–205 ; (11), 223–224).—M. reviews recent advances in non-ferrous foundry practice, both in the elaborate mechanical foundry with its self-supporting ancillary departments, and in the versatile jobbing shop. 35 references are given.—J. H. W.

The Centrifugal Casting of Flanges for [Copper] Pipe-Lines. K. P. Lebedev (*Sudostroenie*, 1946, (6), 21–22).—[In Russian]. A simple machine is described for the centrifugal casting of flanges in copper alloy (90 : 10 brass or a manganese bronze). The method results in a much smaller number of wasters than does sand casting.—N. B. V.

Semi-Continuous Casting : Suggested Developments for Increasing Output. H. Hocking (*Metal Ind.*, 1947, **70**, (1), 13).—H. outlines the advantages of the semi-continuous casting machine over the Junghans continuous-casting

machine, and discusses means of increasing the output of the former by reducing the non-productive portion of the cycle and speeding up machining of the billets, especially turning and sawing.—J. H. W.

Semi-Continuous Casting : Suggested Improvements in Operating Technique. H. Hocking (*Metal Ind.*, 1947, **70**, (19), 342).—H. points out the requirements for a semi-continuous casting foundry, so as to make full use of the high output that the process offers.—J. H. W.

Continuous Casting of Light Alloys. Jean-Marie Peloutier (*Rev. Aluminium*, 1947, (**131**), 84–93).—An account of continuous casting as applied to aluminium alloys, with particular reference to Duralumin and to billets. Details are given of the moulds, water-cooling arrangements, and of the clearances between mould and moving base. Hollow-billet casting is also discussed. Vol. of cooling water required are given, and a formula is derived relating lowering speed to billet radius ; the curve connecting the two latter is a hyperbola. The actual curve relating lowering speed to billet radius varies with the material ; these are classified as pure aluminium, which is prone neither to segregation nor cracking ; as alloys not subject to internal stress, which are prone to segregation but not to cracking (Duralumin) ; and alloys subject to internal stress, which are very sensitive to cracking (aluminium–magnesium–zinc–copper alloys) ; different values for a constant appearing in the hyperbola-type formula are assigned for these three classes of alloy. Curves showing the form of the solidification front are also given, and soundness and segregation briefly discussed.—F. A. F.

Lost-Wax Casting [of Turbine Blades]. H. W. Giesecke (*Westinghouse Eng.*, 1946, **6**, (6), 180–182).—A series of photographs illustrate each step in the precision casting of turbine blades. The process is described in more detail in the accompanying article, and the advantages and limitations of the method are discussed. G. points out how the precision-casting process is important for the fabrication of the more refractory alloys, the principal constituents of which are chromium, cobalt, molybdenum, and tungsten.

—D. M. L.

Precision Casting : Technique Used for High-Melting-Point Nickel Alloys. H. Evans, P. S. Cotton, and J. Thexton (*Metal Ind.*, 1947, **71**, (1), 3–6 ; (2), 23–26).—See *Met. Abs.*, this vol., p. 114.—J. H. W.

Die-Casting for Aluminium Engines. Gilbert Close (*Light Metal Age*, 1947, **5**, (8), 6–7).—A brief description of plant and production methods at the new McCulloch Motor Corpn. plant at Los Angeles, U.S.A.—M. A. V.

Die-Casting Inserts : Recommended Technique for Magnesium Alloy Castings. J. L. Erickson (*Metal Ind.*, 1947, **71**, (7), 129–130).—E. describes the use of inserts to take advantage of the high strength : weight ratio of magnesium die-casting alloys for use as bearings.—J. H. W.

Crucible Melting Furnaces [for Die-Casting]. —— (*Light Metals*, 1947, **10**, (112), 229–232).—A description of melting and holding furnaces used for the production of gravity-die-cast window frames. Furnace types are standard.—F. A. F.

Die-Casting Progress. I.—The Industry. A. C. Street (*Metallurgia*, 1947, **37**, (217), 3–6).—A survey of present applications of die-castings, and an analysis of users in Great Britain.—M. A. V.

Trends in Die-Casting. Fred C. Ziesenheim (*Light Metal Age*, 1947, **5**, (9), 14–15, 20).—Notes are given on recent tendencies in the use of aluminium, magnesium, and zinc die-castings.—M. A. V.

XVI.—SECONDARY METALS : SCRAP, RESIDUES, &c.

German Practice in Refining Secondary Aluminium. James T. Kemp (*Light Metal Age*, 1947, **5**, (8), 8, 11–13).—See *Met. Abs.*, 1947, **14**, 391.
—M. A. V.

Zinc Oxide from Brass Scrap. A. G. Arend (*Paint Technol.*, 1947, **12**, (141), 329).—A. describes briefly the preparation of zinc oxide from brass scrap, using a special furnace practice whereby the oxide is retained inside the furnace. The product is impure, but has been used in the preparation of light-green paint compositions, &c.—H. A. H.

[**Treatment of**] **Brass Pickle Wastes.** —— (*Metal Ind.*, 1947, **71**, (4), 69).—A summary of a survey made at a large brass plant in Connecticut, U.S.A., includes a brief description of the treatment of these wastes so as to lessen the degree of pollution and recover by-products of value.—J. H. W.

XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

Insulation of Metallurgical Furnaces and Steam Boilers. A. S. Gaĭdin (*Za Ekonomiyu Topliva*, 1946, **3**, (1), 15–17; *C. Abs.*, 1946, **40**, 4452).—Five combinations of sawdust, asbestos fibre, and diatomite were tested as external insulation for metallurgical furnaces and boilers. Sawdust 30–70, asbestos 0–60, and diatomite 0–50% were used in these compositions. The ingredients were dry-mixed by hand and then water was added to form a consistency of thick cream. On crowns, the insulation was applied directly, on vertical walls wire netting was used in some cases. The preferred method, not always followed, is to apply first a gas-impermeable layer, then a heat-insulating layer, and on top a sealing layer. The gas-impermeable layer was made of ground Dinas 60, powdered asbestos 30, and refractory clay 10%. The dry mix was combined with a 30% solution of water glass. This layer was ordinarily 3–8 mm. thick. The heat-insulating layer was up to 100 mm. thick. The sealing layer was an aqueous suspension of asbestos, its thickness 5–10 mm. The heat-insulating layer dries and, where the temp. is high, the sawdust burns out. The result is a light-weight (0·24–0·42 kg./m.³), porous, monolithic product.

XVIII.—HEAT-TREATMENT

Gas-Fired Heat-Treatment Plant [**for Aluminium Alloys**] —— (*Aircraft Prodn.*, 1947, **9**, (106), 316–317).—A description of heat-treatment plant in use at the de Havilland Aircraft factory for the solution treatment, annealing, and ageing of aluminium alloys.—W. A. M. P.

Stabilizing Aluminium Castings. Avery C. Jones (*Metal Progress*, 1947, **51**, (5), 775).—The dimensional stability of aluminium alloy castings is improved by treating them at sub-zero temp.; the same kind of physical-chemical change is involved as in the hardening of steel. Hydraulic valves for aircraft, cold-treated at −150° F. (−101° C.) were much improved in quality.—J. L. T.

Beryllium-Copper Formed Parts: Advantages of Fixture Heat-Treatment. —— (*Product Eng.*, 1947, **18**, (2), 118–121).—Hardening of beryllium copper is caused by phase changes in metallurgical structure : hard beryllium copper cannot be bent or formed because of its low ductility, but has the highest

physical properties after heat-treatment. Stampings are made flat and bent to the desired form in fixtures that hold the parts to required dimensions during heat-treatment. Since heat-treatment removes any internal stresses, no warpage or spring-back occurs when the parts are removed from the fixture. The choice of a proper heat-treating cycle is discussed. The manufacture of coil springs by this method is described in detail.—H. V.

Induction Heating by High-Frequency Methods. O. F. Gullick (*Machinist* (*Eur. Edn.*), 1947, **91**, (24), 831–837 ; (25), 867–872).—G. describes the principles, methods of application, and limitations of induction heating, and discusses the equipment and types of application best suited to the process.
—J. H. W.

Heat-Treating Developments. —— (*Eng. Materials Processes*, 1946, **4**, (10), 285–287).—A review, reprinted from *Power and Works Engineer*, 1945, (Nov.).—H. A. H.

XIX.—WORKING

Light-Alloy Extrusion : Production of Sections for the Aluminium House. —— (*Metal. Ind.*, 1946, **69**, (24), 485–487 ; (25), 509–511).—An account is given of the extrusion of sections for aluminium houses by the Reynolds Tube Company.—J. H. W.

Nickel Alloy Extrusion : The Zenith Works of Henry Wiggin and Co., Ltd. A. B. Graham (*Metal Ind.*, 1947, **71**, (13), 265–266).—G. describes a plant primarily concerned with the hot extrusion and subsequent cold working of bars, sections, turbine blading, and tubing in nickel alloys.—J. H. W.

*****Extrusion : Some Experimental Work on Hot-Short Alloys.** H. A. Unkel (*Metal Ind.*, 1946, **69**, (21), 423–425 ; (22), 445–447).—In order to gain information on the extrusion of alloys that exhibit brittleness under hot-working conditions, experiments were carried out on the extrusion of three copper alloys containing (1) tin 6, zinc 3, lead 7% ; (2) tin 9, lead 21% ; (3) tin 10, lead 10%. In particular, the effect of the application of an envelope of plastic metal on the development of cracks from the periphery of the rod at its exit from the die orifice was investigated. The influence of temp. on the extrusion of Duralumin-type alloys is also discussed.—J. H. W.

Production Processes. Their Influence on Design. XX.—Impact Extrusion. Roger W. Bolz (*Machine Design*, 1947, **19**, (2), 115–119).—Cf. *Met. Abs.*, 1946, **13**, 339. A wide range of parts formed by the impact-extrusion process is illustrated, and drawings are given of essential requirements when designing for this process. B. discusses the type of process used for different metals and different sizes of shells. He points out that punch strength limits the dimensions to a max. shell length of about six times the inside diameter of cylindrical parts.—D. M. L.

Recent Developments in Wide Aluminium Strip Rolling. W. B. Green (*B.T.H. Act.*, 1947, **19**, (8), 228–234).—After a brief description of the rolling process, G. gives details of the large rolling mills installed since 1938 at Banbury, Rogerstone, and Falkirk. The electrical driving and control equipment is illustrated and described.—D. M. L.

Rolling Aluminium : Falkirk Plant of the British Aluminium Co., Ltd. —— (*Metal Ind.*, 1947, **71**, (13), 259–263).—Details are given of an entirely new mill for sheet-rolling aluminium, designed, constructed, and operated by the British Aluminium Co., Ltd., at Falkirk during the war.—J. H. W.

Hot-Rolling : Notes on the Production of Light-Alloy Slabs. Henry Vita (*Metal Ind.*, 1947, **70**, (12), 193).—V. discusses the casting of ingots for hot rolling, the effect of metal and non-metal impurities in causing rolling defects, and the causes of cracking during rolling.—J. H. W.

*On the Possibility of Increasing the Elongation for Pass in Rolling Non-Ferrous Metals [Copper, Zinc]. S. I. Gubkin, P. S. Istomin, and I. L. Perlin (*Compt. rend.* (*Doklady*) *Acad. Sci. U.R.S.S.*, 1946, **52**, (7), 585–588).—[In English]. Plastic deformation of metals is dependent, *inter alia*, on the kind of principal stress under which the deformation is taking place. The authors suggest three-directional tension and three-directional compression tests to obtain the value of the deformability of metals, which is defined as the max. strain which the metal can take without failing under a given state of stress. The deformability of zinc and copper was determined under various rates of strain at temp. between 20° and 400° and 20° and 900° C., respectively. The results showed that these metals could undergo much greater reductions for pass than the reductions used in the current practice. This conclusion was confirmed experimentally.—V. K.

Analysis of the Work of the Electric Drive of a Tandem Cold-Rolling Mill. V. K. Popov (*Trudy Leningrad. Politekhn. Inst. im. M.I. Kalinin*, **1946**, (1), 131–145).—[In Russian]. Mathematical-theoretical.—N. B. V.

Modern Small Rolling Mills. G. A. Phipps (*J. Iron Steel Inst.*, 1947, **157**, (2), 247–261).—P. describes the lay-out, drafting practice, operational details, and economics of a number of mills (mostly American), rolling rods, bars, strip, angles, and merchant sections in steel. P. contrasts British and American practice and concludes that, while this country is well provided with efficient units for the production of steel rod and strip, it is very badly equipped with high-production merchant mills.—R. W. R.

Mechanical and Electrical Features of Primary Hot-Rolling-Mill Auxiliaries. I.—Mechanical Features. W. W. Franklin (*J. Iron Steel Inst.*, 1947, **157**, (2), 262–271).—F. describes and discusses recent developments in the design of a number of heavy rolling-mill auxiliaries, including roller tables, breast rollers, manipulators, tilting fingers, screwdown gears, and bloom shears.
—R. W. R.

Mechanical and Electrical Features of Primary Hot-Rolling-Mill Auxiliaries. II.—Electrical Features. P. F. Grove (*J. Iron Steel Inst.*, 1947, **157**, (2), 272–278).—G. discusses " mill-type " electric motors and the rating and duty of electric drives suitable for the rolling-mill auxiliaries described in the preceding abstract. Control gear, power supply, cabling, &c., suitable for the various applications of electric drives are also discussed, and a section is devoted to the lighting of the mill.—R. W. R.

Production Processes—Their Influence on Design. XXVI.—Thread and Form Rolling. Roger W. Bolz (*Machine Design*, 1947, **19**, (8), 145–151).—Cf. *Met. Abs.*, 1946, **13**, 339. B. presents a comprehensive survey of this production process, which is regarded as the fastest method of forming threads. Illustrations show typical thread-rolled products and the latest American machines for the operation.—D. M. L.

Bending Spar Booms [of 75S-T Aluminium Alloy]. —— (*Aircraft Prodn.*, 1947, **9**, (108), 369).—A description of the technique employed by the Ryan Aeronautical Company of San Diego, California, U.S.A., for the bending of heavy spar booms of aluminium alloy 75S-T (approx. equivalent to D.T.D. 687). The cross-sectional area involved was of the order of 7 in.^{2} It was found that 75S-T alloy was easier to work at elevated temp. than any other aluminium alloy, and it was therefore decided to heat the spar booms and bend them at 300° F. (149° C.). The heating process was controlled electronically. Pressure up to 75,000 lb. was applied, and owing to the great amount of compression strain occurring during the forming operations, it was found necessary to cut notches in the flanges of some of the booms to prevent distortion.—W. A. M. P.

*Stretching Aluminium-Clad Alloys. —— (*Metal Ind.*, 1947, **70**, (1), 8).—Experiments were carried out to determine the physical properties of clad

aluminium alloys by stretching to various degrees when in (1) the annealed, (2) the quenched and heat-treated, and (3) the quenched, heat-treated and aged states. It was found that the ultimate strength and, still more, the yield strength of the alloys in states (2) and (3) are improved by stretching; and that the greatest increase in strength is obtained by stretching the alloy in state (2) to 13% increase in length, and in the aged state (3) to 4·64%, when the alloy shows an increase in yield strength of 7 tons/in.² and in ultimate strength of 1·8 tons/in.² over the unstretched alloy.—J. H. W.

Skin Stretching [of D.T.D. 390 Alloy]. —— (*Aircraft Prodn.*, 1947, **9,** (105), 243–248).—An account of Avro developments in forming large air-frame panels, using the specially developed Avro skin-stretching machine. Data are given for the stretching of D.T.D. 390 material in the normalized condition.—W. A. M. P.

Stage-Die Development [Sol-a-Die Method]. —— (*Aircraft Prodn.*, 1947, **9,** (106), 301–302).—A description of the Sol-a-Die method of preparing patterns from the final form. This process consists in preparing a flexible, laminated pattern from the final forming die, which is designed from the finished shape of the part. The flexible replica of the finished part may be unfolded and flattened in order to obtain the necessary form for the pre-paration of the earlier-stage forming dies—a shape with the same surface area as the finished part but of less depth being obtained. It is claimed that this process considerably simplifies the design of intermediate-stage forming dies and that the finished part is characterized by much less severe deformation and thinning of the material.—W. A. M. P.

Metal Bellows : Production from Deep-Drawn Tubes [Hydroflex Process]. —— (*Metal Ind.*, 1947, **70,** (4), 69–70).—The applications of metal bellows in industry are outlined, and the production of these from deep-drawn tubes by the " Hydron " process in America (" Hydroflex " in England) is described. This process involves unrestricted flowing of a thin-walled metal tube under considerable hydraulic pressure in a collapsible die. The bellows are formed in one continuous process, no annealing being required.—J. H. W.

Cutting Oils : Their Construction, Application, and Value to Production. Arthur E. Lawson (*Eng. Materials Processes*, 1946, **4,** (10), 280–284).—A survey of the selection, properties, and applications of cutting oils. Soluble oils are generally either milky or clear oil–water emulsions. The former contain neutralized sulphonated fatty-oil base and mineral oil, together with emulsion stabilizers, and the latter, sulpho-naphthenic acid or rosin soap. Frequent cleaning when using such emulsions is necessary, owing to the formation of insoluble metallic soaps. Special oils have been developed for aluminium and its alloys, and cast iron. The commonest forms of straight oil are the sulphurized types, and L. discusses their reaction with copper-con-taining alloys and moisture, the importance of viscosity, and their use in grinding and broaching.—H. A. H.

Cutting-Fluid Applications : The Right Cutting Fluid, Properly Applied, Prolongs Tool Life and Improves Surface Quality. Albert W. McCalmont (*Eng. Materials Processes*, 1946, **4,** (12), 361–363).—Reprinted from *Tool Engineer*, 1945, (Oct.). The functions of different types of cutting oil are discussed. A chart showing recommended cutting fluids, depending on the tool material and severity of machining operation for steel and some non-ferrous metals, is included.—H. A. H.

Magnesium Alloy Dust Collection. —— (*Aircraft Prodn.*, 1947, **9,** (105), 276).—A description of the Multiswirl Unit Dust Collector equipment for eliminating the fire hazard during grinding operations on magnesium alloys.
—W. A. M. P.

Properties of Hard Abrasives. —— (*Materials and Methods*, 1947, **26,** (5), 115).—Engineering File Facts No. 152.—J. L. T.

XX.—CLEANING AND FINISHING

Degreasing : Applications of a Synthetic Wetting Agent [Teepol X]. —— (*Metal Ind.*, 1947, **70**, (23), 425).—The improvements in aqueous degreasing effected by the use of Teepol X are described.—J. H. W.

The Cleaning of Metals. I.— Choice of Process and Cleaning Agent. R. Groves (*Metallurgia*, 1947, **37**, (217), 40–42).—Types of dirt and characteristics of the various main kinds of cleaning agents are considered.—M. A. V.

Films and Surface Cleanliness. (Harris). See p. 190.

Frosted Aluminium. —— (*Metal Ind.*, 1947, **71**, (11), 228).—A low-cost frosted finish on aluminium, similar to that of finely etched glass, is obtained by etching the metal in hot caustic soda solution, rinsing in cold water, immersing in a solution of 2 parts conc. nitric acid and 1 part water, and finally rinsing and air-drying on a steam table.—J. H. W.

Electropolishing Silver to Reduce Finishing Costs. Daniel Gray (*Metal Finishing*, 1947, **45**, (5), 60–61, 65; and (summary) *Metal Ind.*, 1947, **71**, (7), 128).—G. describes the use of an alkali–cyanide bath for minimizing the hand buffing of electrodeposited silver.—J. H. W.

*****The Electrolytic Polishing of 18–8 Stainless Steel and Nickel Silver.** H. Evans and E. H. Lloyd (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 73–84; and *Metal Ind.*, 1947, **71**, (1), 10–12; (3), 51–52).—E. and L. describe electrolytic-polishing experiments on 18–8 stainless-steel and nickel-silver cutlery. The variables investigated were : (*a*) composition and (*b*) temp. of the electrolyte, (*c*) c.d. at the anode, (*d*) time of polishing, and (*e*) original surface finish of the anode. They suggest that the process has distinct possibilities for finishing stainless steel, but that further work is desirable for nickel silvers.

—J. H. W.

Production Processes—Their Influence on Design. XXIII.—Barrel Finishing. Roger W. Bolz (*Machine Design*, 1947, **19**, (5), 131–136).—Cf. *Met. Abs.*, 1946, **13**, 339. The barrel finishing of precision products is surveyed. B. discusses the various abrasives used and the effect of the process. Illustrations are given of a wide range of metal parts finished in this way and also of representative types of barrels used in the U.S.A.—D. M. L.

Production of [Fine Surface Finish on] Hydraulic Equipment. —— (*Aircraft Prodn.*, 1947, **9**, (104), 226–231).—A review of the means by which an unusually fine surface finish (average surface roughness not exceeding 2 micro-in.) is obtained on small hydraulic-pump components manufactured from Nitralloy material. Surface examination and tool-room practice are discussed in some detail.—W. A. M. P.

XXI.— JOINING

New American Automatic-Feed Soldering Tool. —— (*Eng. Materials Processes*, 1947, **5**, (17), 51).—The " Eject-O-Matic " soldering iron of the American Multi-Products Tool Co. is described.—H. A. H.

Temperature Chart for Soldering, Brazing, and Welding Processes. Richard C. Hitchcock (*Product Eng.*, 1947, **18**, (10), 171).—Reference book sheet.

—J. L. T.

Assembly of Aluminium Parts by Furnace- and Dip-Brazing Methods. A. H. Petersen (*Product Eng.*, 1947, **18**, (2), 115–117).—P. gives a large number of illustrations showing design details for aluminium parts to be joined by furnace- or dip-brazing methods. He also discusses the use of

jigs, assemblies, tack welding, and riveting to hold assemblies during brazing. These, of course, depend on the size and shape of the work to be brazed. Hints are given for cleaning and protecting the brazed part. Flushing with boiling water for cleaning, and dipping in chromic acid for corrosion protection, are advised.—H. V.

Jointing of Brass : A Survey of Methods and Applications [—I, —II]. Edwin Davis (*Welding*, 1947, **15**, (5), 204–213 ; (6), 271–279).—[I.—] D. begins by summarizing the properties of brasses and then discusses the methods employed for joining these alloys. Increasing use is being made of silver solders, and a wide range of compositions are available. The more expensive alloys of higher silver content may prove more economical in use because they are easier to manipulate. In complex assemblies the use of a solder of high m.p. on the first joints made, facilitates subsequent jointing at adjacent points with solders of lower m.p. Because of its high m.p., borax cannot be used as a flux, boric acid and alkali bifluorides being employed in most flux mixtures. The copper–phosphorus alloys are mentioned as being satisfactory if due cognizance is taken of their brittle character. Solders are usually applied by the torch, significant points in technique being the use of a uniform gap, of 0·002–0·005 in., in the joint, into which the solder can flow, and the melting of the filler rod by contact with the assembly and not directly by the flame. [II.—] D. discusses furnace brazing, resistance brazing, and welding of brasses. Silver solders may be used for joining brass in a manner analogous to the use of copper for brazing mild steel. Careful assembly, an appropriate flux, and clearances of approx. 0·004 in. are required. Salt-bath brazing is satisfactory, and for mass production induction heating may offer advantages. Resistance welding of the higher-copper alloys is impracticable, but resistance brazing may be employed by interposing a thin piece of silver solder between the members. To obtain a good colour match when gas welding, a filler rod containing 1–3% more zinc than the parent plate should be used. No edge preparation is used on plates up to $\frac{1}{8}$ in. thick. The use of an oxidizing flame is essential to avoid porosity in the weld and excessive loss of zinc by fuming. Metallic-arc welding, using rods of the same composition as the plate, is not at present practicable. Tin-bronze rods may give porous welds, but aluminium-bronze electrodes have given satisfactory results when applied to the repair of castings. Spot welding may be applied to the $\alpha + \beta$-brasses, although this is impossible with the higher-copper alloys. Electrode pressures of 30,000–50,000 lb./in.² are used with a welding time of 6–18 cycles. Resistance butt welding is used for joining brass stock in the wire trade.—P. H.

Metallic Joining of Light Alloys.—V. —— (*Light Metals*, 1947, **10**, (112), 214–223).—Cf. *Met. Abs.*, this vol., p. 69. The author deals with fusion welding of aluminium wire and strip by electrical methods, mainly for components for the electrical industry. High speed, the avoidance of the use of flux, and smooth weld contour are claimed for the resistance methods described. Lengthy summaries of various relevant patents are given, including British Patents Nos. 558,472/44 ; 560,500/44 ; 564,617/44 ; 570,681/45 ; and 575,883/46.—F. A. F.

Design and Fabrication of Welded Magnesium Tanks for Aircraft. R. J. Cross (*Light Metal Age*, 1947, **5**, (1), 8–15).—Cf. *Met. Abs.*, this vol., p. 166. General principles of design are outlined, and details given of welding technique.—M. A. V.

†**Welding Metallurgy : Recent Progress in the Non-Ferrous Alloy Field.** J. G. Ball (*Metal Ind.*, 1947, **71**, (10), 199–202 ; (11), 219–222, 227 ; (15), 299–301 ; (16), 319–322 ; (17), 345–346, 348 ; (18), 367–369).—B. gives a comprehensive review of recent progress in the welding of aluminium, mag-

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nesium, and copper, and their alloys, by all the various processes. 30 references are given.—J. H. W.

Welding in Great Britain. Arthur Dyson (*Engineering*, 1946, **162**, (4213), 356; and *Metallurgia*, 1946, **34**, (204), 327–328).—Reports of D.'s Presidential Address to the Institute of Welding, 1946.—W. G. A.

Welding in the U.S. Aircraft Industry [—I]. R. Grimaud (*Aircraft Eng.*, 1947, **19**, (224), 331–333).—G. discusses the use and practice of spot welding in the United States aircraft industry. A detailed account is given of the preparation of the material to be welded, and a comparison is made between the practice of various factories in this respect. Visual-inspection methods are briefly discussed.—W. A. M. P.

*Porosity of Metallic-Arc Welds Made with 5% Silicon–Aluminium Alloy Electrodes.** V. J. D. Hill and D. C. F. Lunn (*Welding*, 1947, **15**, (2), 54–60; correspondence, (3), 107).—Arc welds made in $\frac{3}{8}$-in.-thick half-hard aluminium with 8-S.W.G. aluminium–5% silicon electrodes dried at 180° C., were found to exhibit gross porosity. Suitable adjustments in technique made possible the production of porosity-free welds and resulted in an increase in tensile strength of approx. 0·5 tons/in.² H. and L. attributed the porosity to the dissociation in the arc, of moisture contained in the coating. Scratch-brushing the plate to remove the hydrated oxide film and pre-heating to 185° C. to remove moisture was not effective in reducing porosity, but the pre-heating did result in a flat weld bead. The residual moisture content of the electrode coatings, when baked at 100° C., was approx. 2·0%, but by increasing the baking temp. this figure was progressively lowered till at 500° C. only 0·2% moisture remained, and the welds became free from porosity. In addition to the effect on porosity, the increased baking temp. improved the characteristics of the electrode, resulting in less splutter, better slag flow, and easier slag removal.—P. H.

Arc Welding in Making Aluminium Doors. M. N. Vuchnich (*Light Metal Age*, 1947, **5**, (8), 10).—A description of the design and construction of sectional " roll-up " doors. Welding is done with aluminium–5% silicon alloy electrodes.—M. A. V.

*Hot Cracking of 7% Aluminium Bronze Multi-Run Welds.** E. C. Rollason and W. D. Marsh (*Welding*, 1947, **15**, (6), 252–256).—Single-run butt welds in 7% aluminium bronze have a tensile strength of approx. 26 tons/in.², whereas multi-run welds in the same alloy may have a strength of only 7 tons/in.², owing to the presence of hot cracks. It is suggested that this drop in tensile strength in the case of the multi-run weld is a result of the restraint imposed by the second and subsequent runs. Bend tests carried out at a variety of temp. have shown that max. brittleness occurs at 600° C. Similar tests carried out on cold-drawn core wire showed that there was no loss of ductility at elevated temp. When the grain-size of the wire was increased by high-temp. annealing, however, hot bend tests again showed a loss of ductility between 500° and 700° C. It was concluded that hot cracking is a result of grain-boundary weakness inherent in the alloy at 600°–700° C. The presence of small amounts of some undesirable impurity which precipitates at low temp. but re-dissolves at higher temp., is thought to be a possible explanation of this phenomenon. It is pointed out that the complex aluminium-bronze alloys do not suffer from hot cracking, possibly because of the smaller grain-size usually associated with these poly-phase alloys.—P. H.

Contact Arc-Welding. P. C. van der Willigen (*Philips Tech. Rev.*, 1946, **8**, (6), 161–192).—Cf. *Met. Abs.*, this vol., p. 167. A modified method of arc welding is described in which the electrodes are dragged over the surface of the work-piece, thus overcoming the great difficulty usually experienced in maintaining the length of the arc const. The new method described uses an automatically ignited arc. The electrodes contain a large part of the metal

as a fine powder in the insulating coating, rendering the latter conductive. It is claimed that faster and more reliable welds can be made using these contact electrodes.—D. M. L.

Argon-Shielded Metal-Arc Welding of Aluminium. Gilbert C. Close (*Light Metal Age*, 1947, **5**, (10), 6–8).—The advantages of the process are outlined. A table of tensile strengths of welded joints in sheets of 52S, 3S-O, and 61S alloys is included.—M. A. V.

Production Applications for Inert Gas-Shielded Arc Welding [of Light Alloys]. H. T. Herbst (*Light Metal Age*, 1947, **5**, (3), 14–17, 21).—Cf. *Met. Abs.*, this vol., p. 70. Details are given of the technique for Heliarc welding magnesium and aluminium.—M. A. V.

Welding with Superimposed High-Frequency Current by Means of the Polytrode. —— (*Eng. Materials Processes*, 1947, **5**, (18), 83–84).—The advantages are outlined of connecting a source of H.F. power, the Polytrode, to the A.C. mains in series with the welding transformers. It is claimed that aluminium and its alloys can be welded by this method.—H. A. H.

Reclamation of Precision Babbitt Bearings by the Gas-Flame Method. R. A. McCarthy (*Iron Steel Eng.*, 1946, **23**, (9), 115–116).—The bearings were steel bushings thinly lined with cadmium Babbitt. In replacing liners, the surface was first tinned, using a light welding torch and a standard flux, and Babbitt then applied with the same torch. Oxides float to the top, and are kept out of the interior by rod and torch manipulation. The method compares favourably for speed with more conventional methods.—M. A. V.

How to Select Wear-Resisting Rods for Welding. Joseph A. Cunningham (*Machine Design*, 1947, **19**, (1), 139–142).—After a discussion of the requirements of hard-surfacing electrodes, C. describes in turn sliding and rolling abrasion, and edge and flat impact. The type of deposit to give the most satisfactory service is described. The spalling that takes place when two layers are used is discussed. C. suggests that spalling can be minimized by selecting an electrode giving a max. carbon content of $2\frac{1}{4}\%$ in the weld deposit. A useful table lists the composition, impact resistance, mechanical properties, and the welding information for nine classes of hard-surfacing electrodes.—D. M. L.

Protecting Mill Equipment with Hard Facing [Hastelloy CHF]. (Wilson). See p. 191.

*****Spot-Welded [24S-T Alclad] Aluminium Lap Joints Designed for Repeated Loads.** R. C. McMaster and H. J. Grover (*Product Eng.*, 1947, **18**, (11), 112–116).—M. and G. summarize a series of fatigue tests on spot-welded lap joints, made to determine the influence of spot size, sheet thickness, and spot pattern on fatigue strength. Most of the test-pieces were made from 24S-T Alclad aluminium sheets, 0·040 in. thick. Fatigue-test results are tabulated for the following conditions of test and material : (1) as received, and after ageing at 370° F. (188° C.) for 10 hr. ; (2) single-row spot-welded lap joints for unequal thickness ; (3) 0·040-in.-thick sheet with various spot-welded patterns ; (4) stress-cycle curves for single-row lap joints for weld energy over a wide range ; and (5) correlation between max. load for shear failure and area within the dark ring of a spot weld. Typical radiographs are also shown.—H. V.

Precision Energy-Storage Spot Welder. Rufus Briggs and Hans Klemperer (*Electronics*, 1947, **20**, (6), 102–104).—A capacitor-type spot-welding apparatus is described and illustrated. The instrument has been successfully applied to the precision spot welding of light-gauge sheet and wire of nickel, molybdenum, tungsten, steel, aluminium, gold, and platinum. A storage tank of 200 μF. capacity is tube controlled and provides a max. storage energy level of 225 W.-sec. The bench-type welding head is illustrated and its construction described.—D. M. L.

The Gluing of Light Metals [Redux Process]. —— (*Light Metals*, 1947, **10**, (112), 234–241).—The author describes applications of the Redux process for sticking aluminium alloy parts together. A temp. of 140°–190° C. is needed, and the parts to be joined must be firmly clamped together for times ranging from 3 to 15 min. Examples include sink and draining-board assembly, joining of stringers and skin of aircraft, and assembling of window frames, furniture, and Duralumin cycle frames.—F. A. F.

Metal–Ceramic Brazed Seals. R. J. Bondley (*Electronics*, 1947, **20**, (7), 97–99).—B. describes a process in commercial use in the U.S.A. for the manufacture of ceramic–metal or glass–metal seals. Ceramics can also be joined to other ceramics by this metal soldering process. The areas to be soldered are painted with a mixture of powdered titanium hydride in a suitable carrier such as cellulose lacquer. The treated ceramic can then be soldered with any solder melting in the temp. range 900°–1000° C. The soldering must be done in a vacuum or a pure hydrogen atmosphere. The necessity of using a metal part with an expansion coeff. nearly the same as that of the ceramic is stressed. It is suggested that the process might be utilized for the production of wiring circuits fired on to ceramic chassis units.—D. M. L.

Powdered Glass for Better Seals to [Kovar] Metal. —— (*Eng. Materials Processes*, 1946, **4**, (12), 357).—A note on making Kovar–glass seals. A suspension of powdered glass is applied to the Kovar and then fused.—H. A. H.

Uniting Wood and Metal : Plymetl. —— (*Modern Metals*, 1947, **3**, (9), 42).—Cf. *Met. Abs.*, 1947, **14**, 35, 77, 286, 412.—N. B. V.

XXII.—INDUSTRIAL USES AND APPLICATIONS

Some Applications of Variable-Section [Aluminium] Semi-Finished Products in Aeronautics. Jean Guillemin (*Rev. Aluminium*, 1947, (131), 79–83).—A discussion of the advantages of varying-section profiles and tubes, as applied to civil aircraft ; examples are given from current French practice.
—F. A. F.

Aluminium " Skin Blankets ". —— (*Light Metal Age*, 1947, **5**, (8), 9, 17).—A new development in aircraft-wing construction is the use of " skin blankets " consisting of 0·040-in.-thick sheet aluminium riveted to each side of tapered corrugations of 0·020–0·072-in.-thick 24S-T alloy. This results in greater strength and rigidity and allows a number of parts to be eliminated.
—M. A. V.

The All-Metal Wheelair Plane. K. S. Coward (*Modern Metals*, 1947, **3**, (8), 28–32).—C. describes the design and construction of a small private aeroplane which is largely constructed of 24S-T alloy.—N. B. V.

Some Design and Structural Features of the Tucker [Automobile]. W. B. Griffin (*Modern Metals*, 1947, **3**, (9), 20–22).—Cf. *ibid.*, 1947, **3**, (7), 12–13 ; *Met. Abs.*, this vol., p. 121. G. gives a general description of the Tucker car, in which extensive use is made of aluminium alloy. The specific applications of aluminium will be described in greater detail in a later article.—N. B. V.

Aluminium Talk Around Detroit. —— (*Modern Metals*, 1947, **3**, (9), 35).—Owing to shortage of steel, American automobile manufacturers are investigating the possibilities of using aluminium for many components.
—N. B. V.

Aluminium Alloy Bearings. H. Y. Hunsicker (*Machine Design*, 1947, **19**, (1), 121–127).—The mechanical and physical properties of aluminium bearing alloys are tabulated ; and graphs illustrate the effects of some of the alloying elements used, and of different cold reductions, on the tensile pro-

perties and on the seizure resistance of the bearings. The design principles of these aluminium alloy bearings are discussed and information given about their behaviour in service.—D. M. L.

Aluminium. Its Properties which Determine Its Suitability for Use in Brewing Equipment.—I. R. B. Mears (*Brewers' Digest*, 1946, **21**, (6), 41–44; *C. Abs.*, 1946, **40**, 4475).

The New Wear [Aluminium] Bridge. F. J. Walker (*Light Metals*, 1947, **10**, (112), 224–225, 227–228).—Brief general remarks are given on bridge design, ending with a short description of a newly designed bridge for the river Wear, to be of double-leaf bascule type and made in aluminium alloys. A weight saving of about 40% is claimed as compared with an equivalent steel bridge.—F. A. F.

Architecture Awakens to the Value of Light Metals. G. H. Friese-Greene (*Light Metal Age*, 1947, **5**, (3), 8–13, 33–34).—Brief details are given of the properties and characteristics of light metals and alloys from the point of view of their decorative and architectural use. Anodizing and dyeing are also considered.—M. A. V.

Prefabricated Aluminium Buildings. Philip Murray (*Light Metal Age*, 1947, **5**, (7), 11–13, 17).—Descriptive.—M. A. V.

A Review of the " Alcrete " House. —— (*Light Metal Age*, 1947, **5**, (9), 12–13).—A description of the " Alcrete " prefabricated aluminium and concrete house.—M. A. V.

Aluminium Building Wire. E. W. Renfree (*Modern Metals*, 1947, **3**, (8), 14–15).—As a result of the shortage of copper, aluminium wire is now being extensively used in America in housing and factory construction. Aluminium has the same electrical resistance as copper wire two gauges smaller. Connections and terminals are made in the same way as for copper.—N. B. V.

Reynolds Reduces Prices on Aluminium Building Products. —— (*Modern Metals*, 1947, **3**, (8), 22–23).—Greatly increased demand for aluminium in building products in America has resulted in a price reduction of approx. 20%. The principal uses are indicated, and price comparisons are made with conventional materials for a number of components.—N. B. V.

Aluminium Castings for Oil Burners Cut Costs. Wm. F. Klockau (*Modern Metals*, 1947, **3**, (9), 19).—N. B. V.

Coach Baggage Cars Made Principally of Aluminium. —— (*Modern Metals*, 1947, **3**, (9), 40).—The coaches described, which belong to the New York Central System, are constructed entirely of aluminium alloys, except for the bolsters, cross-bearers, and end sills, and a weight saving of 34% is thereby achieved.—N. B. V.

Aluminium in Trailer Construction. —— (*Light Metal Age*, 1947, **5**, (7), 15).—A brief account of processes in the manufacture of trailer coaches by Westcraft, Inc., Los Angeles, U.S.A.—M. A. V.

Aluminium Gravity Conveyors. —— (*Modern Metals*, 1947, **3**, (8), 24).—The gravity, wheel-type conveyor described is 12 in. wide and made in 5-, 6-, 8-, and 10-ft. lengths. The principal alloy used is 61S-T.—N. B. V.

Fantasy in Display [Use of Light Alloys]. —— (*Light Metals*, 1946, **9**, (97), 104–107).

Pressed [Aluminium Alloy] Pistons for Heavy-Duty Diesel Engines. L. P. Gibson (*Eng. Materials Processes*, 1946, **4**, (11), 316–321).—The operating conditions of heavy-duty oil-engine pistons are discussed, together with the alloy properties required to meet them. Aluminium alloys are most suitable, and the compositions and primary physical and mechanical properties of " Y " alloy and aluminium–12% silicon alloy are tabulated. The fundamental differences between cast and pressed pistons are outlined, and a brief description is given of the manufacture of pressed pistons at Specialloid, Ltd.

—H. A. H.

Aluminium and Magnesium in the Electrical Industries. B. J. Brajnikoff (*Light Metals*, 1943, **6**, (68), 425–433; (70), 568–570; 1944, **7**, (76), 221–223; (77), 300–308; (81), 471–479; 1945, **8**, (84), 16–24; (86), 136–144; (88), 205–211; (89), 278–287; (91), 385–401; 1946, **9**, (96), 51–52, 54–56; (98), 163–166; (101), 295–301; (103), 393–397; (106), 609–618; 1947, **10**, (114), 325–332.—W. G. A.

†**Light Alloys in Rectifiers, Photocells, and Condensers.** —— (*Light Metals*, 1944, **7**, (75), 162–172; (77), 276–298; (80), 437–458; (81), 505–512; (82), 525–529; (83), 565–566; 1945, **8**, (84), 25–41; (85), 87–100; (87), 193–202; (88), 246–254; (89), 292–304; (90), 348–359; (91), 409–414; (92), 459–462; (93), 479–491; (94), 559–576; 1946, **9**, (96), 9–21; (98), 144–151; (99), 215–220; (100), 231–235; (101), 318–325; (102), 372–378; (103), 408–413; (105), 517–524; (107), 637–642).—W. G. A.

Aluminium and Preserved Foods. René Chevillotte (*Rev. Aluminium*, 1947, (**131**), 100–108; and (abridged translation) *Sheet Metal Ind.*, 1947, **24**, (244), 1583–1586, 1590).—An account of the use of aluminium in the canning industry. Methods of making deep-drawn cans are briefly described; seamed cans are made from quarter-hard aluminium and sealed with a plastic material, and hence cannot be used for autoclave processing. The probability of attack by various foods is discussed; meat, pastes, pork products, and tripe are harmless to the container; fruit must be considered in relation to its pH. Anodized sheet may be used for certain foods from which attack is more likely, as for example, unsweetened condensed milk. Aluminium cans are not as strong as tin cans, and this affects processing technique.—F. A. F.

Home Front Surveyed [Uses of Aluminium and Magnesium]. —— (*Light Metals*, 1947, **10**, (112), 243–252).—An illustrated survey of the application of aluminium to domestic and allied uses. Bottle crates made partly of magnesium alloy are also described.—F. A. F.

Light-Weight [Aluminium] Lawn Sweeper. —— (*Modern Metals*, 1947, **3**, (8), 26).—N. B. V.

Aluminium Alloys : Utilization of Light Metals for Marine Purposes. E. G. West (*Metal Ind.*, 1947, **71**, (9), 173–176).—W. gives an historical summary of the applications of aluminium alloys to marine engineering and indicates the probable trends in the next few years, from the point of view of the naval architect.—J. H. W.

New [Aluminium Slide-Film] Projector and Protectochrome Mounts. —— (*Modern Metals*, 1947, **3**, (8), 20–21).—The projector consists of castings in aluminium alloy 356 and the mounts are of $3S\frac{1}{2}H$.—N. B. V.

Aluminium for Rotobowling Equipment. —— (*Modern Metals*, 1947, **3**, (9), 24–25).—The 16-lb. ball used in this new American indoor sport is cast in No. 195 aluminium alloy.—N. B. V.

Light-Alloy Spools and Reels. F. A. Rappleyea (*Modern Metals*, 1947, **3**, (9), 14–16).—The use of aluminium and magnesium alloys in making spools, bobbins, and reels for the textile and wire industries, is described.—N. B. V.

Light-Alloy Utility Service Equipment. R. A. O'Neill (*Modern Metals*, 1947, **3**, (9), 33–34).—A 285-lb. cantilever extension ladder mounted on a lorry and used by telephone linesmen in maintenance work, is described and illustrated.—N. B. V.

Re-Designing for Light Metals. William Graf (*Light Metal Age*, 1947, **5**, (10), 10–13, 20).—Design theory is discussed generally, and applied to the re-design of a steel crane in aluminium, achieving a considerable saving in weight, and many consequent advantages.—M. A. V.

Preparing Bearing Shells for Babbitting. A. A. Goodman (*Metal Progress*, 1947, **51**, (5), 776).—The slots in large steel and bronze bearing shells are now replaced with a serrated bore; a considerable saving in Babbitt is thereby effected.—J. L. T.

Metallic Bearings. H. L. Smith (*Iron Steel Eng.*, 1946, **23**, (11), 73–76).— An engineer's reply to a questionnaire on design and operation of metallic bearings, circulated by the Association of Iron and Steel Engineers.—M. A. V.

Random Remarks on Plain Shaft Bearings. E. Ingham (*Power Transmission*, 1947, **16**, (190), 1139–1142).—I. deals with the advantages and disadvantages of plain bearings as compared with ball or roller bearings. He then discusses the materials for bearing liners, dividing them in two classes : brass or bronze, and Babbitt. The wear and tear of bearings, and lubrication are surveyed.—H. V.

Bearing Developments Up-to-Date. Henry W. Luetkemeyer (*Metal Progress*, 1946, **50**, (5), 918).—An extended abstract of a paper read to the Cleveland Section of the Society of Automotive Engineers.—W. G. A.

Unfamiliar Uses of Bronze. Geo. K. Dreher (*Western Metals*, 1946, **4**, (5), 23–27 ; *C. Abs.*, 1946, **40**, 4646).—Some of these uses are for the retaining nuts which join airscrew assemblies to engine crank-shafts, for the nuts used in holding together assemblies exposed to corrosive conditions, for use in forming dies for steel, for sound damping in steel assemblies, for damping mechanical shocks, for low-temp. applications, especially in the form of aluminium bronzes, and for applications where non-magnetic properties are essential.

The Use of Copper in Post-War Building. [I.—] Copper Development Association. [II.—] Recent Developments and Future Trends. —— (*Eng. Materials Processes*, 1946, **4**, (10), 296–298).—A review.—H. A. H.

Copper and Its Alloys : Applications in Marine and Allied Engineering. E. Voce (*Metal Ind.*, 1947, **71**, (9), 163–166).—V. discusses the applications of copper alloys for wiring and piping in some detail, especially as applied to marine engineering.—J. H. W.

Beryllium Copper. —— (*Eng. Materials Processes*, 1946, **4**, (15), 465–470).—From " Beryllium Copper, its Properties and Applications ", published by Mallory Metallurgical Products, Ltd., London.—H. A. H.

Indium in Industry. William S. Murray (*Eng. Materials Processes*, 1946, **4**, (10), 287–289).—A survey of industrial applications in dental alloys, decorative finishes, brazing alloys, bearings, Indalloy coatings, and plating. Characteristics of the cyanide, sulphate, fluoborate, and sulphamate plating baths are listed, together with operating details of the " Clear-Cy-an-In " plating process.—H. A. H.

Magnesium Alloys : Their Value in Engineering Applications. F. A. Fox (*Metal Ind.*, 1947, **71**, (4), 63–66 ; (5), 86–88, 90).—F. reviews the properties of the magnesium alloys, largely developed for war-time applications, that render them suitable for general engineering and commercial uses.—J. H. W.

Recent Developments in Magnesium Products. C. H. Mahoney (*Modern Metals*, 1947, **3**, (9), 36–39).—The products described include hand trucks, dock-boards, car-loading tubes, ladders, sporting goods, slide rules, vacuum-cleaner handles, and string plates for a miniature piano.—N. B. V.

[U.S.] Army Ordnance Turns to Magnesium. C. H. Corey (*Modern Metals*, 1947, **3**, (8), 16–18).—Reprinted from *Army Ordnance*, **1947**, (Mar.). An account of the uses to which magnesium alloys have been put by the U.S. Army Ordnance Dept. These include : launcher tubes for 4·5-in. aircraft rockets, cast 60-mm. mortar base-plates, and cast artillery wheels. Many other applications are expected in view of the decision that in future all military equipment will be designed to be airborne.—N. B. V.

Magnesium for Textiles : Roving Spools, Wool Bins, Lay Beams. J. Walraven (*Modern Metals*, 1947, **3**, (9), 29–30).—N. B. V.

Molybdenum : Practical Structural Material. John Gelok (*Westinghouse Eng.*, 1947, **7**, (5), 156–159).—Molybdenum ingots weighing 250 lb. are now being produced and thus the fabrication of large parts from this metal has

become possible. G. describes the development of the use of molybdenum, particularly its application in lamps. The production of the metal is described and a table is given of its properties in comparison with the other common metals. The special points to be kept in mind for machining, spinning and forming, welding, and riveting of the metal, are stressed. Present-day and possible future applications of the metal and of molybdenum alloys are discussed.—D. M. L.

Nickel in Marine Engineering : Propelling Machinery—Condenser Tubes—Electrical Equipment—Navigational Instruments—Catering Equipment. A. E. Hanson (*Metal Ind.*, 1947, **71**, (9), 167–170 ; (10), 207–208).—H. describes the many applications of a number of nickel-containing bronzes and high-nickel–copper alloys in a modern passenger liner.—J. H. W.

Metallurgy and the Gas Turbine. —— (*Eng. Materials Processes*, 1947, **5**, (17), 54–55).—Reprinted from *Indian Eng.*, 1946, **120**, (3), 161–162 ; see *Met. Abs.*, this vol., p. 76.—H. A. H.

Gas-Turbine Forgings: Development of High-Creep-Strength Austenitic Steels [and Nimonic 80]. (Oliver and Harris). See p. 185.

Nickel and High-Nickel Alloys : Their Use in the Pulp and Paper Industry. H. O. Teeple (*Paper Ind. Paper World*, 1946, **27**, 1523–1529 ; *C. Abs.*, 1946, **40**, 4214).—Applications are discussed in the mechanical process (screens), sulphite, soda, and sulphate pulping, paper production (screens, refiners, paper machine), and by-product recovery. A flow sheet is used to illustrate these applications, which depend on the corrosion-resistance of nickel, Inconel, Monel, and Hastelloy C.

Trend for Alloy-Lined Equipment in the Paper Industry. H. A. Schmitz, Jr. (*Paper Ind. Paper World*, 1946, **28**, 230–231 ; *C. Abs.*, 1946, **40**, 4882).—Corrosion problems can be solved by the proper use of alloys.

Permanent-Magnet Materials. D. J. Desmond (*Eng. Materials Processes*, 1946, **4**, (11), 322–326).—A survey of the properties and development of materials used for magnets. Carbon-, tungsten-, chromium-, and cobalt steels, as well as alloys such as Alni, Alnico, Ticonal, and Alcomax and some not commercially available, are critically discussed.—H. A. H.

Rhodium : Engineering Properties and Uses. (Hunt). See p. 178.

Characteristics of the Selenium Rectifier. I. R. Smith (*Westinghouse Eng.*, 1946, **6**, (6), 192–196).—In comparison with the copper oxide rectifier the selenium type shows the advantages of smaller size, less weight, and a more favourable temp. characteristic. The construction of rectifier elements of various sizes is described and the electrical properties discussed at some length. S. presents a number of graphs to illustrate the electrical performance.—D. M. L.

Barrier-Layer Rectifiers. F. A. Vick (*Sci. Progress*, 1947, **35**, (140), 668–675).—The present position in the theory of metal rectifiers is reviewed.
—F. M.

Characteristics of Silver and Copper for Use as Electrical Contacts. B. W. Jones and L. L. Zickrick (*Product Eng.*, 1947, **18**, (11), 104–107).—A summary of electrical and metallurgical properties of silver and copper for electrical contacts. Graphs deal with the current–resistance characteristics of fine silver and copper contacts aged in hydrogen sulphide, with the current–resistance characteristics for silver, and with the contact resistance of copper and silver under a pressure of 20 lb./in.^{2} The effect on contact tips of heavy current and soldering is discussed.—H. V.

Sprayed Metal for Wiring. —— (*Electronics*, 1947, **20**, (9), 132).—A brief description is given of a method now being used for forming several electronic circuits in one operation by spraying metal into grooves cut in dielectric panels. The thickness of the metal deposit at the conductors is about 0·005 in.—D. M. L.

Small Zinc Alloy Die-Castings : Economic and Design Advantages. J. Sacks (*Product Eng.*, 1947, **18**, (11), 86–89).—S. deals with die-castings in zinc alloy of a max. weight of $\frac{1}{2}$ oz. A chart gives comparisons of cost, design features, and physical characteristics of zinc alloy die-castings, brass screw machining, brass stamping, steel screw machining, plastic moulding, iron castings, bronze castings, and cold forging and swaging.—H. V.

XXIII.—MISCELLANEOUS

Handling and Storing of Light Metals. Benjamin Melnitsky (*Light Metal Age*, 1947, **5**, (9), 10–11, 20).—A general discussion of the use of storage racks and fork trucks.—M. A. V.

Studies on the Toxicity of Inhaled Cadmium. I.—The Acute Toxicity of Cadmium Oxide by Inhalation. H. M. Barrett, D. A. Irwin, and E. Semmons (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (5), 279–286).—A study of the toxicity to various animals of arc-produced cadmium oxide fumes (see also abstracts below).—R. W. R.

Studies on the Toxicity of Inhaled Cadmium. II.—The Acute Lethal Dose of Cadmium Oxide for Man. H. M. Barrett and B. Y. Card (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (5), 287–293).—Cf. preceding abstract. B. and C. report the results of an investigation carried out in a Canadian factory where cadmium oxide fumes evolved from cadmium-plated rivets in an annealing furnace had previously caused two deaths. The conditions of the accident were reproduced as closely as possible and atmospheric samples were taken at various points in the factory. In addition, animals were exposed to the fumes evolved from the furnace. It was concluded that, for man, the lethal dose of thermally produced cadmium oxide is not more than 2900 min. mg./m.^{3}; the lethal dose of arc-produced cadmium oxide is probably not more than 1500 min. mg./m.^{3}—R. W. R.

A Study of Industrial Exposures to Cadmium. Frank Princi (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (5), 315–320).—Cf. preceding abstract. P. describes the results of a clinical study of twenty workers in a cadmium-smelting plant. No systematic symptoms of cadmium intoxication, other than yellow stains on the teeth of those men who had had long exposure, could be identified, although all showed evidence of cadmium absorption. It is concluded that, in chronic exposures, there is rapid elimination of cadmium from the body and that there is no cumulative effect. The data suggest that cadmium may not be as great an industrial hazard as previously thought.—R. W. R.

The Possibility of Chronic Cadmium Poisoning. Harriet L. Hardy and John B. Skinner (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (5), 321–324).—Cf. preceding abstract. H. and S. describe the results of clinical studies on five workers in a plant engaged in the cadmium coating of bearings. The workers had had between 4 and 8 years' exposure. The authors discuss the possibility of chronic poisoning, but reach no definite conclusions.—R. W. R.

The Control of Lead Exposure in Storage-Battery Manufacture. Grant S. Winn and Carroll Shroyer (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (5), 351–356).—W. and S. describe precautionary measures in force in a lead-battery works. These include good ventilation, medical examination and education of new workers, and regular blood and urinary checks on workers in exposed hazardous positions; surveys of the atmospheric concentration of lead in various parts of the plant are carried out at monthly intervals. Clinical data assembled over a period of 10 years are presented. It is concluded that, with proper precautions, an average atmospheric concentration of not more than 5

mg./10 m.^{3} is permissible. Figures are given for normal, abnormal, and unsafe urinary lead concentrations.—R. W. R.

Industrial Electronic Equipment Uses. W. C. White (*Electronic Ind. and Instrumentation*, 1947, **1**, (3), 6–7).—A reference list is given of articles, on various branches of electronics, that appeared in 1946. Some subjects of metallurgical interest covered include : general control processes ; furnaces, heating, and flames ; resistance welding ; H.F. heating, dielectric and induction ; chemical analysis ; and materials testing. W. points out that very few foreign publications are included.—D. M. L.

New Metals for Old. (Sir) Edward Appleton (*Eng. Materials Processes*, 1947, **5**, (19), 127–130).—Cf. *Met. Abs.*, this vol., p. 132.—H. A. H.

Non-Ferrous Metal Developments on the Pacific Slope. Richard J. Anderson (*Chem. Eng. News*, 1947, **25**, (38), 2704–2709).—Statistics relating to the output, for the first half of 1947, of companies producing aluminium, magnesium, chromium, copper, mercury, lead, zinc, and zirconium, are given. Future tendencies and developments, as well as present production methods, are considered.—H. A. H.

[Discussion on G. H. Stanley's Paper :] " Metals and Metallurgy in the Twentieth Century." —— (*J. Chem. Met. Min. Soc. S. Africa*, 1947, **47**, (11), 417–418).—Cf. *ibid.*, 1946, **46**, (9/10), 235–267 ; *Met. Abs.*, 1947, **14**, 80. Author's reply to discussion.—V. K.

Non-Ferrous Metallurgy : A Century of British Progress. J. C. Chaston (*Metal Ind.*, 1947, **71**, (1), 7–9 ; (2), 28–30).—C. recalls some of the greatest British metallurgists, chemists, physicists, and engineers, and indicates some of their outstanding contributions to non-ferrous metallurgy.—J. H. W.

A View of the Future of Metals. Ernest E. Thum (*Metal Progress*, 1946, **50**, (5), 844–846).—An editorial survey of prospects in the United States.
—N. B. V.

Sponsored Research [Fulmer Research Institute]. —— (*Aircraft Prodn.*, 1947, **9**, (106), 288).—Particulars are given of the new Fulmer Research Institute.—W. A. M. P.

Common-User Research : New Laboratories [of the Fulmer Research Institute] at Stoke Poges. —— (*Metal Ind.*, 1947, **71**, (2), 33).—A brief description of the new Fulmer Research Institute laboratories.—J. H. W.

The Place of the Metallurgist in Industry. (Sir) Arthur Smout (*Metallurgia*, 1947, **37**, (217), 7–10).—M. A. V.

Metallurgical Education : The University Training of Metallurgists. D. Hanson (*Metal Ind.*, 1947, **70**, (2), 25–28 ; (3), 47–48).—An address to the London Local Section of the Institute of Metals. H. discusses the considerations by which a course of metallurgy at a university can be judged. These are the provisions made for attaining a high general standard of pure science and mathematics and for acquainting the student with the latest knowledge of the particular developments in his chosen field of study.—J. H. W.

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XXV.—BOOK REVIEWS

Introductory Physical Metallurgy. By Clyde W. Mason. A Series of Lectures on Introductory Physical Metallurgy Presented to Members of the A.S.M. During the Twenty-Ninth National Metal Congress and Exposition, Chicago, October 18–24 1947. Med. 8vo. Pp. [v] + 134, with 76 illustrations. 1947. Cleveland, O. : American Society for Metals, 7301 Euclid Avenue. ($3.00.)

This book is a record of a series of elementary lectures on physical metallurgy presented to members of the American Society for Metals during the 29th National Metal Congress and Exposition held at Chicago in October 1947. It is difficult to imagine the type of audience, and the needs of the audience, with which the author had to deal, and it may therefore be somewhat unfair to him to describe the treatment as superficial. Judged on its own merits as a contribution to metallurgical literature, however, superficiality is the book's main characteristic. In spite of having been prepared so recently, the account is not really up to date. Throughout, the terminology is loose. The frequent colloquialisms give the impression that the work is a verbatim reproduction of the lectures; the personality and gestures of the lecturer are missing, and there is nothing in the printed word to replace them. There are several examples of loose, confused, ambiguous, or even faulty statements, while there is a marked tendency to avoid explaining many technical and scientific terms, but to enclose them in inverted commas, as if the latter magically made clear the meaning of the enclosed word or phrase.

The book begins with a very cursory description of the extraction of metals from ores, and goes on to consider the crystalline and physical nature of metals. The description passes abruptly from atoms with valency electrons rotating in orbits to metals with an electron gas, and it is easy to imagine that misleading ideas could be picked up by uncritical reading of this and other more or less theoretical sections. In this chapter, X-ray methods in physical metallurgy occupy but 14 lines. Solid solutions are next considered, and here a very brief description of some of the more modern work is attempted, though with several important omissions. The freezing of alloys is described; segregation is touched on but inverse segregation ignored. The working and annealing of metals is discussed, together with creep and fatigue, and this is followed by a chapter on what is termed the " unmixing " of solid and liquid solutions. Here, precipitation and precipitation-hardening are described without any reference to Preston or to Guinier, or even to the excellent fundamental work carried out in America. Brasses and bronzes are next dealt with, and in this chapter opportunity is taken to discuss order and disorder in 15 lines.

The remaining chapters are concerned with the metallurgy of iron and steel, the heat-treatment of steel, cast iron, and corrosion, and the uniformly superficial standard is maintained. In view of its importance, the martensite transformation is particularly inadequately described, and there is confusion between processes of this type and precipitation phenomena involving nucleation and growth. The book contains but two references and no bibliography.

The scope of this book is far too wide for its size. It would have been better to have restricted the scope, or to have extended and strengthened the treatment. As it stands, it is difficult to think of any class of reader to whom this Introduction could be recommended, though doubtless those who attended the lectures will be glad to have a permanent record of them.—G. V. RAYNOR.

Metallurgy for Aircraft Engineers, Inspectors, and Engineering Students. By R. A. Beaumont. Demy 8vo. Pp. viii + 269, with 181 illustrations. 1946. London : Sir Isaac Pitman and Sons, Ltd. (25s. net.)

It is probable that many engineers like to know more about the materials they use than the simple mechanical or physical properties that may be conveniently enshrined in a purchasing or standard specification. The additional knowledge they desire is likely to vary with the circumstances in which they are placed and the particular functions they exercise. If an engineer is concerned to submit his metals to further manufacturing operations, such as pressing, spinning, forging, or heat-treatment, it is evident he should know something of the properties that govern their behaviour in the course of such operations. Beyond that, almost any engineer is certain to encounter, from time to time, service failures of his structures or engines; and then will be anxious to possess some understanding of the materials he has used, to help him to reach an explanation of such failures.

On different occasions efforts have been made to provide engineers with information of this kind, but have usually succeeded only in inverse proportion to the amount of metallurgical knowledge selected for exposition. These publications have demonstrated that the engineer is better served by the provision of a reasonably full and understandable explanation of an appropriate section of metallurgical science, than by presenting him with an array of descriptive statements connected with each other only by their relation to some particular metal or metallurgical process, and not reinforced by any adequate explanation of the principles involved.

Metallurgy is a very large subject, and a wise engineer would probably employ the services of a trained metallurgist to help him in his problems rather than attempt, by reading a comparatively slim volume, to delude himself into a belief that he understands the science. Bacon's aphorism about " a little learning " is very applicable in such a case. Mr. Beaumont in his book on " Metallurgy " has endeavoured to cover the whole field of the common engineering metallic materials in a volume of 250 pages, and also to throw in chapters on mechanical testing and the measurement of high temperatures. Naturally he provides a great deal of

information, though it is rather curiously assorted. An engineer who reads the book will probably be interested by many of the sections; but might have profited more from the effort if many pages filled with rather cursory statements of a factual nature, lacking any adequate explanatory reinforcement, had been replaced by a reasoned account of selected metallurgical phenomena.

The book is unlikely to be of much use to metallurgists as a class, and its main value to engineers may well be to introduce them to the subject and make them seek elsewhere for a more profound and, therefore, more satisfying treatment. It would be unfair to an engineer to lead him to believe that an adequate account of metallurgy can be presented within this compass, brave though Mr. Beaumont's effort may be. The book suggests that the author has been content to take his knowledge and data from a somewhat restricted range of sources. These are all very well in themselves, but such a choice does not excuse the author if some of his chapters suggest either bias or a limited acquaintance with the subjects he treats.

—LESLIE AITCHISON.

Rarer Metals. By Jack De Ment and H. C. Dake. With a Foreword by Colin G. Fink. Demy 8vo. Pp. xiv + 392, with 38 illustrations. 1946. Brooklyn, New York : Chemical Publishing Company, Inc. ($7.50 net.)

It is difficult to write temperately of this volume. It sets out to describe the extraction, properties, detection, and uses of twenty so-called rarer metals (including the platinum metals, tungsten, and molybdenum) and with the aid of a spate of references glosses the text with a superficial air of scholarship. The reader will quickly find, however, that the treatment is sketchy, uncritical, and often inaccurate, but—worst of all—often just sufficiently close to the truth as to be dangerously misleading. A gross example may illustrate the point. "The platinum metals can be plated on glass ", the authors write, after giving compositions of platinum electroplating solutions, and continue " Bright silvery blackish, or gray films may be employed in optics, for coating lenses and large telescope mirrors. . . . Since rhodium has an extremely high reflectivity and is easily plated, extended use for this metal has been found for searchlight reflectors." Platinum-metal films are certainly produced on glass, but by evaporation, not electrodeposition; and searchlight mirrors which are electroplated with rhodium are metal mirrors, not glass ones. So little indication is given of the complications of many of the extraction processes that the uninstructed reader might well wonder why many of the rare metals remain in that category. He would imagine, for instance, that the separation of hafnium from zirconium is relatively straightforward, particularly if he notes that " one distinction between hafnium and zirconium is that the oxalate of hafnium is soluble in excess oxalic acid, but the oxalate of zirconium is not ". In fact, of course, there is no specific chemical test for hafnium. The general style is illustrated by the following paragraph : " One of the latest schemes applied to the extraction of germanium is that of Tchakirian. The method will be discussed rather fully, because it is based on the use of oxalic acid, the ' queen ' of the acids in rare-metal treatment. Time and again when the strong mineral acids fail to attack rare metal ores, oxalic acid is comparatively effective." The " full " description which follows this piece of nonsense occupies about 200 words, rather less than a page, and concerns a method in which the ore is attacked with nitric acid. Of the more preposterous or useless statements there is space here to quote only one : " A new binary alloy of uranium and nickel, containing 66% uranium, is useful in that it is very resistant to corrosion, and is attacked with difficulty by *aqua regia* ". Useful for what ? On no grounds can this book be recommended.

—J. C. CHASTON.

Manual of Foundry and Pattern-Shop Practice. By Otis J. Benedict, Jr. Cr. 8vo. Pp. x + 361, with 272 illustrations. 1947. New York : McGraw-Hill Book Co., Inc. ($3.25) ; London : McGraw-Hill Publishing Co., Ltd. (16s. 6d.).

This book is by an American author, and, so far as the title is concerned, one would imagine that it was intended for the foundryman. If so, then British readers will be disappointed. For a book published in 1947 it is completely out of date. Furthermore, it is badly arranged and indexed. Many of the chapter titles are misleading, and the illustrations and terminology could be improved. Important aspects of foundry work have been omitted, and considerable space has been given to subjects of little moment. No consideration is given to the vital question of design of castings. Some thirty pages are devoted to a detailed description of the way to operate sand-testing equipment, yet not even the most elementary guide is given as to how the results obtained should be applied in practice. Core ovens are treated in a similar manner, but no indication is given of the range of baking temperatures likely to be needed. The recommended compositions of cast irons employed for various applications date back to 1932, and no attempt has been made to correlate casting section with composition. The author's efforts to describe pouring temperatures are quite ineffectual, but amusing : " Good, hot iron has a bright, slightly straw-colored appearance, as it cools, it loses bright-

ness and becomes more nearly dull red. At the point where it is beginning to form a ' skull ' in the ladle, it will have a perceptibly tinny sheen near the lining. With a little experience, the caster can easily judge the condition by these indications.'' Only one short paragraph is devoted to the measurement of molten-metal temperatures : " There are several types of pyrometer but only one, the optical type, is much used on cast iron. In using this instrument, it is important to focus on a surface that is free from the luminous patina that forms over still metal.'' One begins to wonder if the author has any metallurgical or foundry experience. The book is full of similar statements. In talking about metallographic terms, there is a description of ferrite : " Ferrite is not visually distinguishable from pure iron, even under the microscope.''

Although the book is described as a Manual of Foundry and Pattern-Shop Practice, it deals only with cast iron. The chapter on Non-Ferrous Metals covers 7 pages, and the book might have been improved if these had been omitted. Part II of the book, on Pattern-Shop Practice, is possibly a little better than Part I, on Foundry Practice, but not much. From the preface one gains the impression, although even this is not clear, that the book has been prepared for the benefit of engineering students. It certainly cannot be recommended as a suitable text-book for anyone seriously taking up foundry work as a career, and it is doubtful whether it will provide even engineering students with any real fundamental information on modern methods of foundry and pattern-shop practice.—FRANK HUDSON.

Trattamenti termici der metalli. (Ricottura Normalizzazione, Tempra, Rinvenimento, Cementazione, Nitrurazione, Invecchiamento, ecc.) By Ramiro Morucci. 24·5 × 17 cm. Pp. viii + 250, with 86 illustrations in the text and 12 plates. 1946. Milan : Ulrico Hoepli. (Lire 350.)

After a general account of the structure of metals and alloys, with a few specimen equilibrium diagrams, the author passes to testing machines and to the control of temperature in heat-treatment. The plates consist of photomicrographs, but there is no description of micrographic technique. Optical and thermo-electric pyrometers are described, but without mention of recent developments. The chapter on thermal treatment deals mainly with alloy steels, and case-hardening, both by carbon and nitrogen, is treated more fully than most of the other subjects. A section on induction hardening follows, with diagrams illustrating its application to small parts. A separate chapter describes the thermal treatment of cast iron, including malleable castings. The non-ferrous alloys receive only brief notice. Tables of definitions and of recommended thermal treatments follow, and the plates show typical structures.

Italian readers will find the book a useful introduction to the subject, but it contains nothing new to other students. There are several minor errors in the diagrams.—C. H. DESCH.

Fundamental Principles and Applications of Induction Heating. By " Heat-Treater.'' Demy 8vo. Pp. 147, with 104 illustrations. London : Chapman and Hall, Ltd. (10s. 6d. net.)

" The uses of induction heating as distinct from induction melting are not as widely known or appreciated in this country as they deserve to be '', writes the author of this little book (which originally appeared as a series of articles in *Sheet Metal Industries*), and he provides a readable, if not very profound account of " the possibilities of induction heating in many branches of production ''. The elementary theory of the process is outlined, some general advice given on coil design, and the principal features of typical motor generator, spark-gap, and valve oscillator heating units are briefly described. The use of induction heating for hardening steel parts of various shapes and sizes is discussed, and the book concludes with a reference to the application of the process for brazing, bright flowing of electrolytic tin-plate, paint and lacquer drying, and other miscellaneous purposes. The volume is by no means an exhaustive treatise on induction heating ; but as far as it goes it is accurate and no extravagant claims are made.—J. C. CHASTON.

Light Metals in Structural Engineering. By L. Dudley. Demy 8vo. Pp. x + 216, with numerous illustrations. 1947. London : English University Press, Ltd. (30s. net.)

For many generations, engineers have been instructed in those branches of science usually termed " strength of materials '' and " theory of structures ''. An enormous amount is known of each of these subjects ; standard courses for teaching them have long existed ; and there is no lack of text-books of different levels to serve the need of students. The justification for this new one is sought in the generally admitted fact that engineers, one might say even to the present date, have thought of steel and cast iron as the only materials of construction. Unless an engineer has been concerned with modern aircraft it is unlikely he has given any serious attention to what are called " light metals '', by which is meant alloys based on alumin-

ium or magnesium. It is generally recognized that most engineers shy away from light metals, and it is fairly certain that one reason for doing so is ignorance of their properties as structural materials, an ignorance that may or may not be justifiable to-day.

In respect of steel and cast iron an engineer has his text-books, his lectures, and all the tables necessary to provide him with the data he uses in design. In addition, there exists a recognized code of practice for such materials of construction. Up to the present, no such corpus of data has been available about the light metals, and in his book Mr. Dudley has taken some of the steps necessary to correct this lack. He has followed the method of presenting the engineering properties of materials and the theory of structures in the traditional way, but throughout his chapters has applied the theory and the results principally to the appropriate light metals and not to the well known ferrous materials. Obviously, the fundamentals of structural theory are independent of the metals to which they are applied—at any rate in the elastic range—the differences being found in the numerical values of the properties incorporated in the formulæ. By providing in each chapter a variety of examples to illustrate the use of light alloys, Mr. Dudley helps to familiarize the reader with some of the consequences of employing such materials. Later he devotes a chapter to the metallurgical characteristics of the light alloys, which is just sufficient for its purpose; and in an Appendix includes, for a very large number of aluminium alloy standard sections, design data comparable with that normally published in all the handbooks for the corresponding steel sections. This is particularly necessary information, for the sections so far standardized in light alloys are not geometrically identical with the well known steel sections.

Mr. Dudley has attempted to achieve two things in one book. He provides a simple text-book on strength of materials and theory of structures, and, in addition, conveys a good deal of data about the structural employment of light alloys. It may be doubted whether a new simple text-book on the theory is necessary, but the author's method certainly results in an understandable introduction of the light alloys to the structural field. Obviously the treatment is limited and, sooner or later, a more advanced text-book ought to appear in which a great deal of Mr. Dudley's present matter can be assumed. It may be hoped that the reception of this volume by structural engineers will be sufficiently favourable to encourage Mr. Dudley to make the further effort. Very few metallurgists will use his book; but, after all, it was not written for them.—LESLIE AITCHISON.

Industry and Research. The Full Report of a Two-Day Conference Arranged by the Federation of British Industries and Held at the Kingsway Hall, London, W.C.2, March 27th and 28th, 1946. Demy 8vo. Pp. viii + 136, with frontispiece and 3 illustrations in the text. 1946. London : Sir Isaac Pitman and Sons, Ltd. (10s. 6d. net.)

Realizing the importance of research to industry in the post-war world, the Federation of British Industries set up an Industrial Research Committee in 1943, and this Committee, under the Chairmanship of Sir William Larke, organized a two-day conference in 1946 which was attended by 1400 delegates. The sessions were entitled (1) Science, Industry, and the Community, (2) Scientific Research and Production, (3) Scientific Research and Industrial Expansion, and (4) The Application of Research in Industry; and the full proceedings are now reported.

It is generally accepted that this country can only maintain its place as a first-class nation if its industries apply the results of scientific research at least as soon as their competitors abroad, and it is significant that the speakers who represented industry were fully alive to the fact that this country has in the past been slow, not in providing ideas, but in their application. Various opinions were expressed on the best methods for preventing this in future, but they all had in common the idea that every industrial organization, even if too small to have a research department, should make a member of staff responsible for keeping in touch with modern developments.

In a conference which ranged over such a wide field, it is not surprising that there is no special treatment of the needs of the metal industry, although a number of points of metallurgical interest were mentioned. Metallurgists will not agree with the speaker who stated that as many as 80% of ferrous and non-ferrous castings are not pressure-tight, nor will they be willing to admit that elimination of porosity by impregnation with plastic should be cited as an improvement in quality resulting from research. This is surely a case where the improvement in quality should result from improved foundry practice, and one, moreover, where much of the scientific research has been done, although the results are not always being applied by the industry.

There is remarkably little overlap in the subject matter of the different papers, which weld together to give an interesting picture of the attitude of present-day progressive industry to research. The book makes interesting reading to-day, and it may seem even more interesting in ten years' time, when it is to be hoped that the time lag between discovery and application will have been considerably reduced.—A. G. QUARRELL.